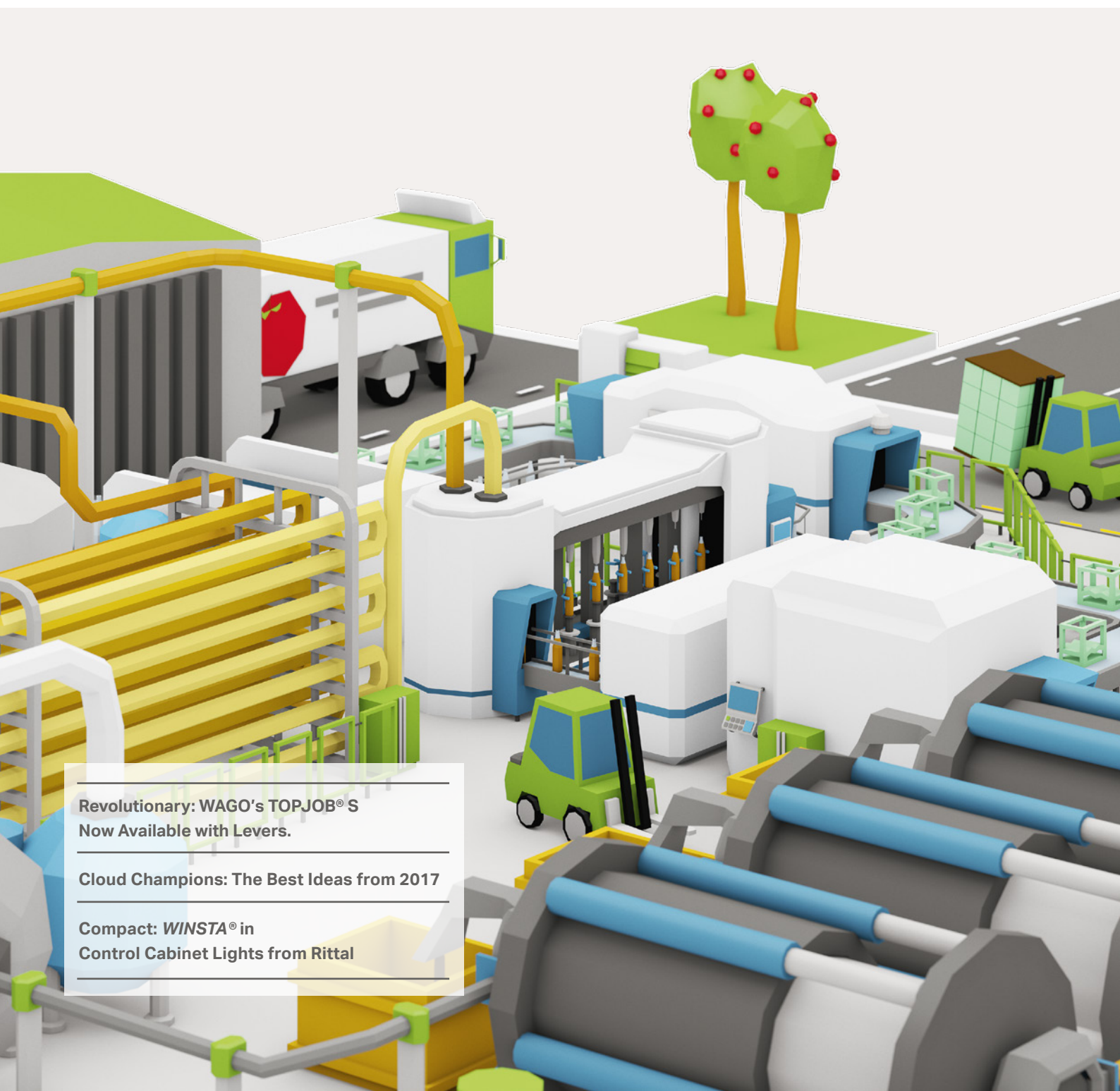# DIRECTFACTORY

WAGO

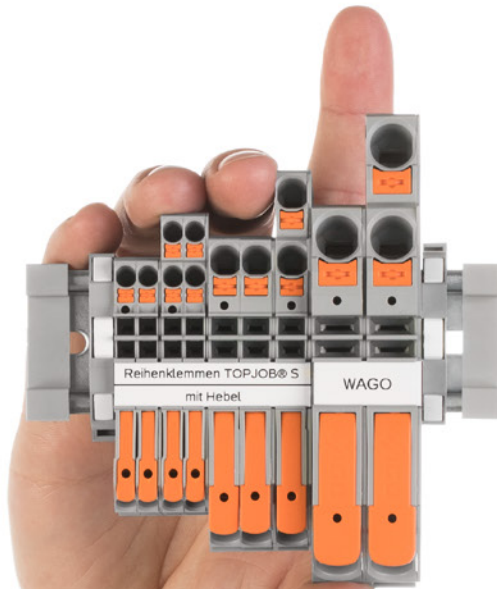## The Key to the Digital Transformation
The Five Technological Aspects of a Smart Factory

Revolutionary: WAGO's TOPJOB® S
Now Available with Levers.

Cloud Champions: The Best Ideas from 2017

Compact: WINSTA® in
Control Cabinet Lights from Rittal

First-Hand
Information!

Firsthand information about innovations in electrical connection technology at WAGO. Like the new **TOPJOB® S Rail-Mount Terminal Block with a lever**.

For the professional by the professional!

The Way to Connect!

www.wago.com/**topjob-s**

EDITORIAL
OPTIMAL DIGITIZATION
FOR OPTIMIZED PROCESSES

Dear Reader,

"Digitization" is one of the most commonly used words of our time. Digitization, which is the conversion of the real into the virtual, applies to much of life. We are often unaware that we have agreed to it, or that we would want to agree. However, it is quite desirable in one area: Managing our increasingly individualized consumer habits.

Manufacturing is only able to react cost-efficiently to the ever declining length of product cycles through sufficiently digitized production. Digitization of manufacturing processes creates the possibility for higher-level controllers to optimally adjust all components or processes, or quickly and variably adapt to new manufacturing processes.

All participating components in the manufacturing process must therefore be networked – either using existing controllers or through additional sensors. This begins with the integration of these necessary sensors, includes the vertical networking of manufacturing islands, and the horizontal linking of the same into higher-level systems, before linking to cloud architecture. In this edition of **WAGO DIRECT**FACTORY, we introduce you to five technological aspects of the smart factory as outlined by Industry 4.0.

These aspects can be paired with modular automation for fast flexibility of the production systems and maximum IT security for digital networking.

The controller family, which features the PFC100 and PFC200, is a central component of our solutions. They form the core around which numerous hardware modules have been adapted and designed, including an increasing number of software functional modules and communication protocols.

Another particularly important element: The protection of your production system from unauthorized access. For us, this means guaranteeing the highest level of IT security.
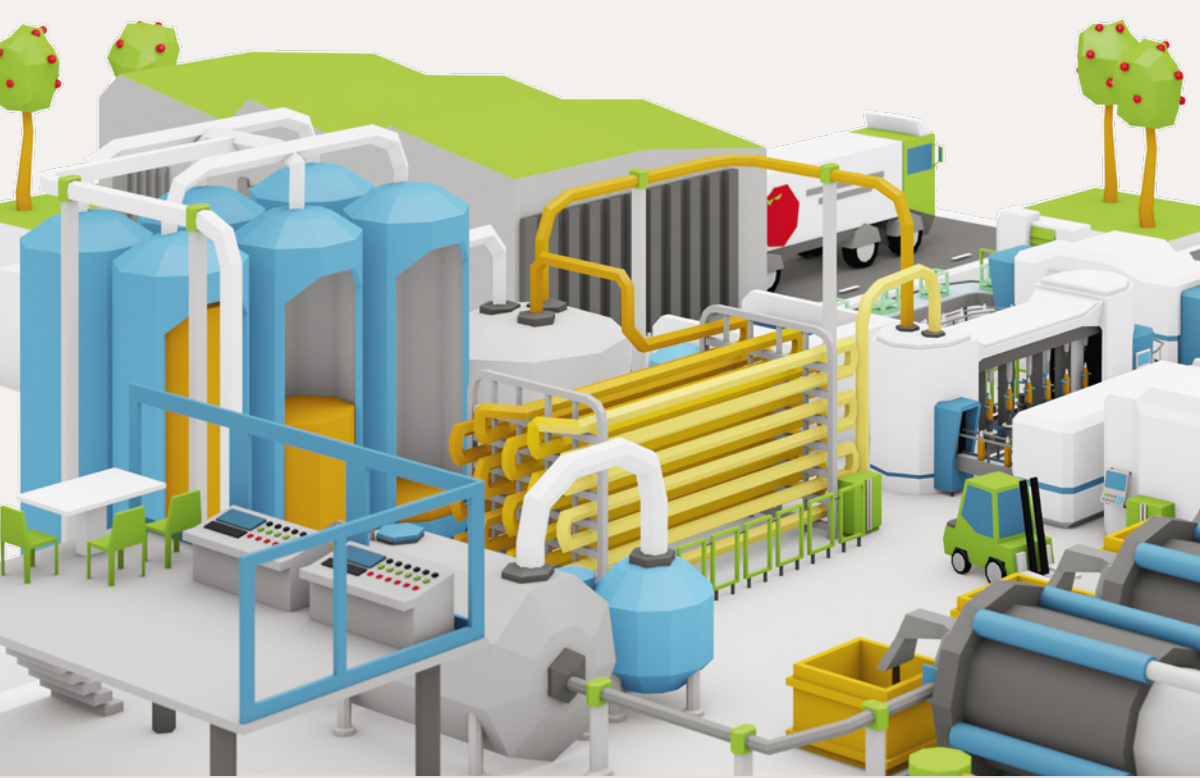By using permanently integrated mechanisms, like SSL/TLS, SSH, VPN, firewalls, MAC whitelists – all based on the LINUX® operating system and the IT security components that it includes – we will meet your expectations.

Explore digitization with WAGO!

Sincerely,

Ulrich Hempen

New title, proven contents:
DIRECTINDUSTRY gives
rise to **DIRECT**FACTORY

COVER STORY

The Key to the
Digital Transformation

On the path to the smart factory, we are no longer asking whether the digital transformation will occur, we want to know how it will happen. The fact is long accepted that digitally networked production has its advantages, particularly in relation to optimized production and increased efficiency. The questions that have become more urgent include: How will the digital transformation work? Which technologies play key roles? WAGO has outlined a plan, which includes starting points for these ideas.

CONTENTS OF THIS ISSUE

The sockets for the new control cabinet lights can be rotated 90 degrees, making space for the connecting cables in cramped conditions.

WINSTA® in Control Cabinet Lights from Rittal

BRINGING LIGHT QUICKLY AND EASILY INTO THE REMAINING CORNERS

Good lighting is an important requirement for safe and error-free work, particularly during control cabinet maintenance. The new control cabinet lights from Rittal perfectly illuminate the control cabinet and also offer numerous advantages during switchgear construction. They are compact, can be easily incorporated and connections are simple thanks to the *WINSTA®* Pluggable Connection System from WAGO.

According to a well-known adage, "All cats are gray in the dark." The background lies in the physiology of the human eye, which has different sensory cells: 120 million rods for vision in low light, and 6 million cones for color vision. The rods are significantly more sensitive than the cones, which is why color vision is impacted so strongly by illumination. This becomes enormously important during maintenance work in a control cabinet. First, one must be able to easily identify the different colors of the conductors.

New LED Light Series for the Control Cabinet

Rittal, a systems vendor, supplies control cabinets, power distribution, air-conditioning systems and IT infrastructure worldwide. The company's portfolio also includes a comprehensive range of accessories for the control cabinets. In 2016, Rittal introduced a new series of LED lights for control cabinets that implemented numerous requests from customers. In addition to optimally illuminating the control cabinet, their customers – primarily in control devices, switchgears and mechanical engineering – place specific value on simple assembly, error-free installation and global usability.

The new control cabinet lights have a side range of voltage inputs from 100 VAC to 240 VAC or from 24 VDC. Regardless of whether the system will be used in Germany, the US, or Asia, the same control cabinet lights can be installed. The LED lights have the corresponding approvals – for example, UL for the US and other North and South American markets.

The modern LED lights provide a light illumination of 400, 600, 900, and 1200 lumens. In order to optimally illuminate the control cabinet, they are equipped with a cover, which is made from transparent plastic and has integrated Fresnel lens structures. The latter focuses the light so that is reaches the lower areas in the control cabinet. If the lights will be mounted on the

side instead of the top, then the cover with the Fresnel lenses can be removed and replaced at a better angle. This guarantees optimal lighting for this installation orientation as well.

Users have three possibilities for mounting the devices: Magnetic fastening, clip mounting on the control cabinet rail or screw mounting. The brackets for screw mounting can be easily folded out from the body of the lights. The mounting is accomplished quickly, regardless of fastening type. This saves time in the electrical shop, and thus costs. "Saving time for our customers was important during product development," explains Kurt-Michael Schaffer, the project leader at Rittal who was responsible for the development of the new LED light series. To guarantee fast and easy use during electrical wiring, the developers at Rittal decided to use pluggable connection technology.

Connection Technology with *WINSTA*®

Rittal relies on *WINSTA*® MINI Pluggable Connectors from WAGO for their electrical connections. They are very compact, making them perfect for integrating into the small lights. Depending on the version of light, two-pole or three-pole *WINSTA*® Pluggable Connectors are used, which can be directly soldered to the PCB inside the light. The three-pole pluggable connectors are also equipped with a socket, and Rittal makes use of these when a PE conductor must be connected in addition to the neutral and phase conductors. The bright lights have a width of 437 mm. In control cabinets that only have a width of 600 mm, the space for plugging in the

In control cabinets that only have a width of 600 mm, the space for plugging in the connectors is scarce because the bending radius of the connection cables has to be maintained. Rotating pluggable connectors facilitate incorporation in the tightest installation spaces.

> *»We have a contact at WAGO, who ensured that the technical information and the CAD data for the pluggable connectors was made available to us very quickly.«*

Rittal project manager Kurt-Michael Schaffer was impressed by the seamless collaboration with the vendors.

connectors is scarce because the bending radius of the connection cables has to be maintained. Therefore, Rittal developed a solution in which the pluggable connectors can be located in the lights and then rotated by 90 degrees to the rear. This gains sufficient space on the back side. "Because the *WINSTA®* Pluggable Connectors are so compact, we could implement this function using standard components," emphasizes Schaffer.

Rittal also provides pre-assembled cables with suitable *WINSTA®* Pluggable Connectors. These only have to be connected at the electrical side and inserted into the lights. This minimizes labor expenses for mounting and wiring. If lights are required in several adjacent control cabinets, these can be easily connected using pre-fabricated cascading connection lines. Customers can also order cables for through wiring directly from Rittal. 10 lights can be supplied with current from

one point for models with sockets, and 15 lights for models without sockets. Both the connecting leads and the junction wires for through wiring are available in black or orange. Schaffer explains this unique option, "The color orange signals that current is still supplied to the lights, even if the switchgears in the control cabinet have been de-energized."

When selecting the supplier for the plug connection technology, it was particularly important for those responsible for strategic purchasing at Rittal that the sockets, plugs, and cable assemblies could be delivered by one manufacturer. WAGO had the manufacturing capacity, which enabled on-time delivery of the large quantities required. The lights are produced by a third party, who also sources *WINSTA®* Pluggable Connectors directly from WAGO. The Dillenburg Counseling Center packages the pre-fabricated conductors in blister packaging, which

are then sent to locations around the globe from Rittal's central warehouse. "This arrangement increases our company's community impact in the region."

Approvals Are Mandatory

The new control cabinet lights offer customers in mechanical engineering and equipment construction the advantage of being used worldwide regardless of mains voltage. The connection technology using the *WINSTA®* Pluggable Connection System is also the same for all models. "The ability to use our lights internationally was required," according to a statement by Rittal sales division, "that meant the approvals for the corresponding markets were also necessary." Thus, as an example, the control cabinet lights have UL approval for the US market. It is important for Rittal that all components are already approved as UL recognized, which makes UL approval for the control cabinet lights

To guarantee fast and easy handling during electrical wiring, the developers at Rittal decided to use pluggable connection technology.

significantly easier to obtain. This, in turn, becomes another compelling reason for selecting the *WINSTA®* Pluggable Connectors.

Rittal created the new LED light series in a very short development time of just one year. According to Schaffer, the seamless collaboration with vendors contributed to this, "We have a contact partner with WAGO who ensured that the technical information and the CAD data for the pluggable connectors was made available to us very quickly."

WAGO could also quickly establish the necessary production capacity for the pre-fabricated connection and junction lines. Sales at Rittal is convinced that, "With WAGO, we have a vendor who is known for the quality of their connection technology."

TEXT MICHAEL RADAU | WAGO

PHOTO RITTAL

During design, the control cabinet and switchgear manufacturer can achieve high efficiency gains through CAD support.

THE MOST INTUITIVE WAYS TO WIRE

WAGO's TOPJOB® S Rail-Mount Terminal Blocks Now Available with Levers

Pull the lever up, insert a conductor, and push the lever back down. The ingeniously simple connection technology that has made WAGO's 221 Series Junction Box Connector a popular all-purpose solution is now available on DIN-rail – as the newest variant to WAGO's trusted TOPJOB® S Rail-Mount Terminal Block family. Conductors can now be easily connected and disconnected by hand in control cabinets, without requiring tools. The user benefits from the simple and intuitive use, especially for in-the-field wiring: The terminal point is clearly marked by the open lever, which reduces the risk of forgetting terminal points when wiring or incorrectly connecting conductors. In addition, both hands remain free for wiring, as the clamping unit does not have to be held open with an operating tool. This convenience facilitates connecting difficult-to-bend conductors with large cross sections.

WAGO's rail-mount terminal blocks with levers are suitable for all types of conductors: Solid, stranded and fine-stranded conductors. Like the tried-and-tested version of the TOPJOB® S Rail-Mount Terminal Blocks with operating slots, the new lever-equipped blocks feature push-in connection technology. In addition to solid conductors, fine-stranded conductors with gas-tight, crimped ferrules and a cross section of 0.75 mm² (18 AWG) can be directly plugged into the unit – and this now includes the rail-mount terminal blocks with levers. The levers simply remain closed in this case. With side conductor entry, the rail-

mount terminal blocks with levers even permit large, difficult-to-bend conductors to be easily connected.

As a first step, WAGO is offering rail-mount terminal blocks with levers in the nominal cross-sections of 2.5 mm² (14 AWG), 6 mm² (10 AWG), and 16 mm² (8 AWG) – primarily for feed-in and the most common conductor cross-sections. These terminal blocks are available in 2- or 3-conductor variants. The field side of WAGO's rail-mount terminal block is lever-equipped; a push-button or operating slot is available for internal wiring. In the future, lever connection will be extended to other products in WAGO's TOPJOB® S Rail-Mount Terminal Block family.
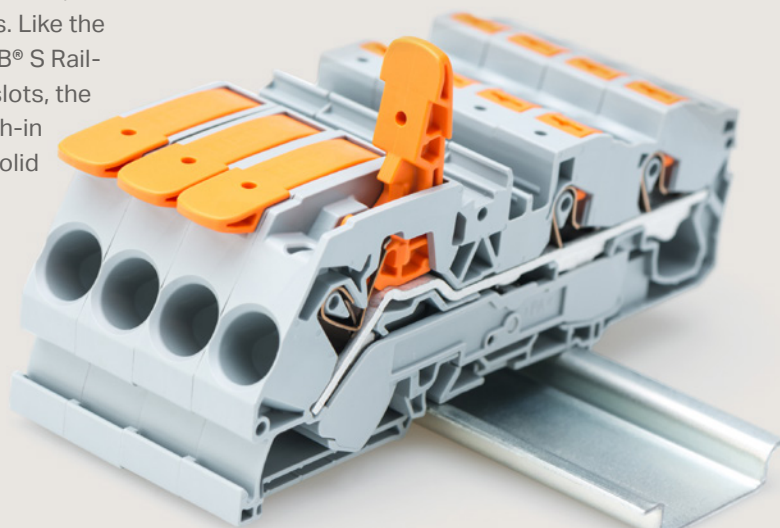
6th Professional Conference: MES as the Focal Point of Industry 4.0

WAGO IN THE MES FOCUS

Manufacturing execution systems (MES) are prerequisites for Industry 4.0 and a pivotal point for digitized production. At the end of January, the MES DACH Association invited participants to the 6th conference, "MES in Focus". The host this year was WAGO in Minden.

"MES in Focus" called, and the MES world came. Discussions involved the most recent trends in the sector and education on topics like digitization and Industry 4.0. Over two eventful days, around 100 participants, including 65 end-users, provided evaluations about the high user benefits

that MES solutions can help to attain in modern manufacturing. This was the sixth event, and this time, it was hosted at WAGO's modern Communication Center, which was built in 2016 for educating trainees and customers.

Eleven Technical Presentations, One Pivotal Point

Ronald Heinze, board member of the MES DACH Association, opened the conference in Minden and introduced important MES foundational concepts to the capacity crowd, with examples

from several sectors. The symposium focused on the motto, "MES as Pivotal Point for Industry 4.0". Eleven presentations related to specific applications provided a well-rounded view of MES – from automation to the ERP levels. The enormous significance that MES can play in Industry 4.0 received specific emphasis. MES experts from companies like SYNCOS GmbH and ORBIS AG presented MES solutions for the different challenges that a smart factory might face. Stefan Hoppe, vice president of the OPC Foundation, reported on the newest developments regarding OPC UA as the preferred framework solution for digitizing production environments from the sensor level up to the IT cloud.

WAGO Enhances Cybersecurity

Rainer Schmutte, Sales Manager Automation at WAGO, presented a look into the future with digital solutions for specific user challenges. These solutions were developed by WAGO. "WAGO automation is the interface between various areas in manufacturing. Individual functions from MDC, ODC, and CAQ can be aggregated and used simultaneously," states Schmutte, emphasizing the efficiency of MES applications from his company. For example, WAGO solutions can be easily integrated via optocouplers or the 750 Series. "We offer customers more than just individual components; we would rather provide complete distribution boxes for machine connections, including integrated automation." The sales manager heavily emphasized cybersecurity in production facilities during his presentation: WAGO is among the global leaders in connecting automation and IoT. "WAGO has demonstrated why it is important to pay attention to security in production areas now – and into the future. Our PFC series has proven particularly reliable," according to Schmutte.

Internal Insights

During a tour through the main production facility at WAGO in Minden, visitors got a direct look at state-of-the-art production methods. The participants gained insight into the production of splicing connectors and in plastics processing, which are among the most advanced in Europe.

"We demonstrated that our production facilities represent a true benchmark," states Schmutte.

Networking between participants was encouraged through targeted support. An interesting program supported the exchange of experiences, for example, during dinner at the GOP imperial palace in Bad Oeynhausen. The conclusion after two exciting days of MES was that the conference was a complete success: Bring on the 7th.

Rainer Schmutte, Sales Manager Automation at WAGO, introduces digital solutions based on specific user challenges as developed by WAGO.

This is the digital future!

THE KEY TO THE DIGITAL TRANSFORMATION

On the path to the smart factory, we are no longer asking if the digital transformation will occur. Rather we are wondering how it will happen. The fact has long been accepted that digitally networked production contains advantages, particularly in relation to optimized production and increased efficiency. How will the digital transformation work? Which technologies play key roles? WAGO has outlined a plan and now provides the bases of these ideas.
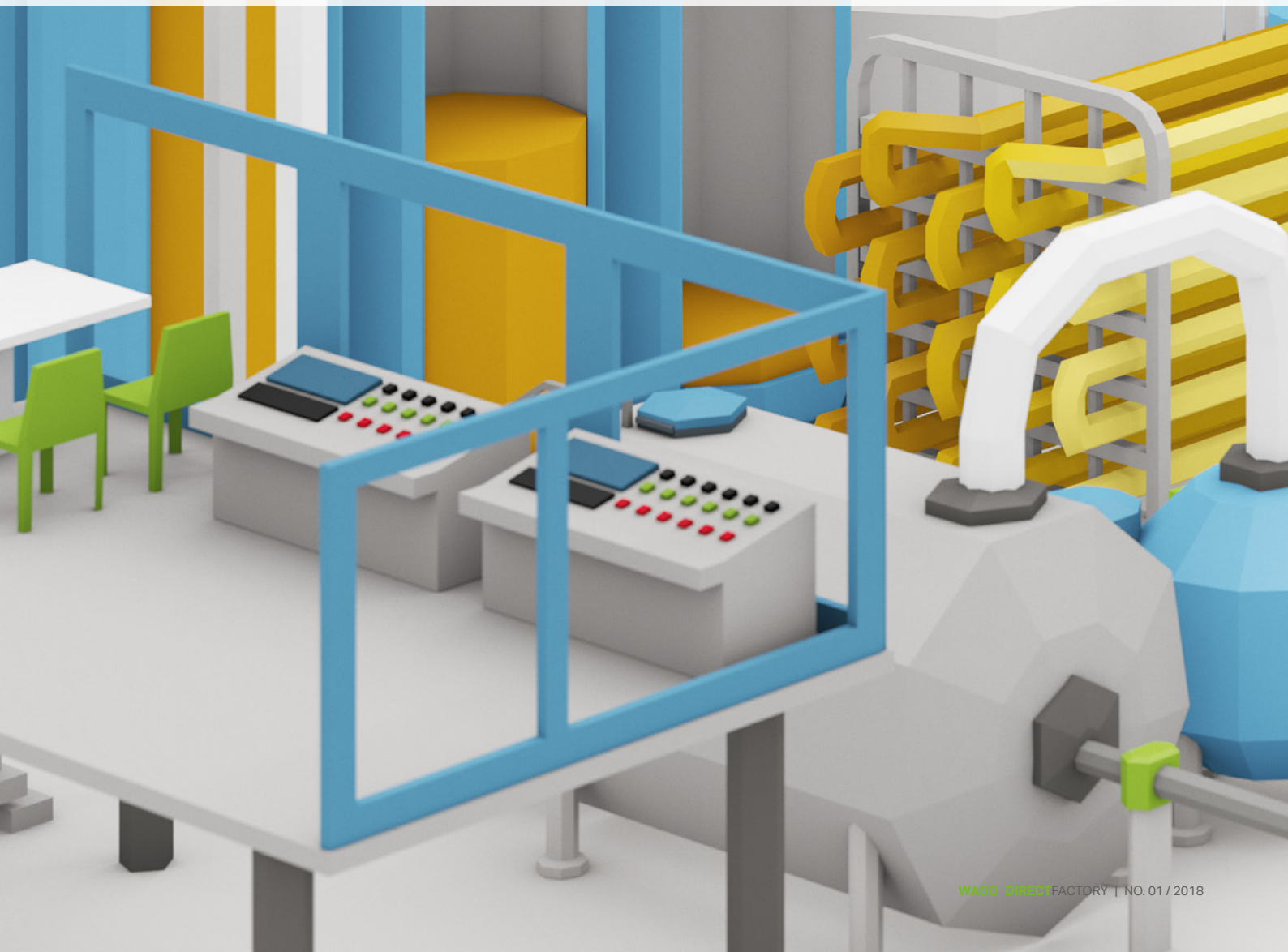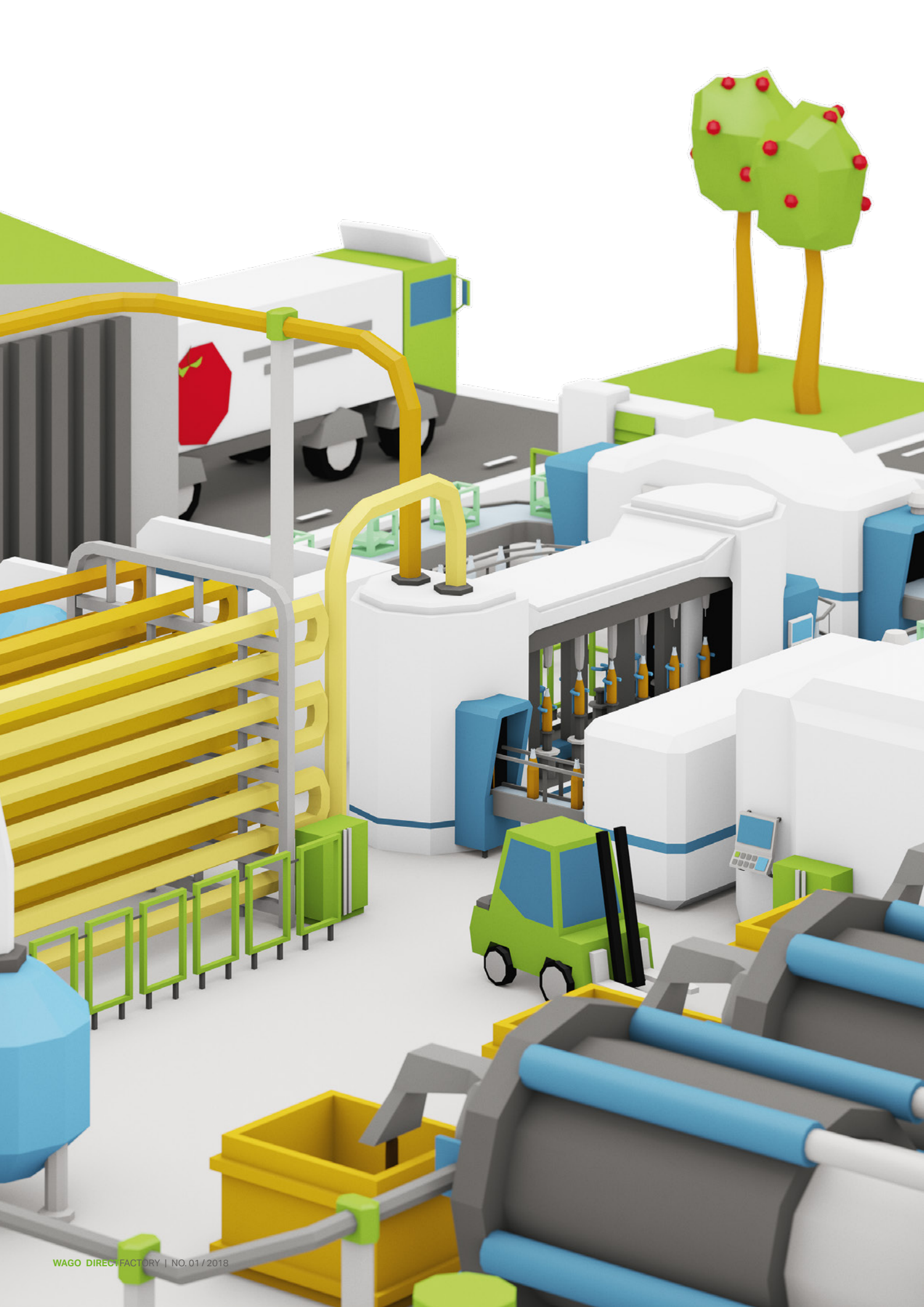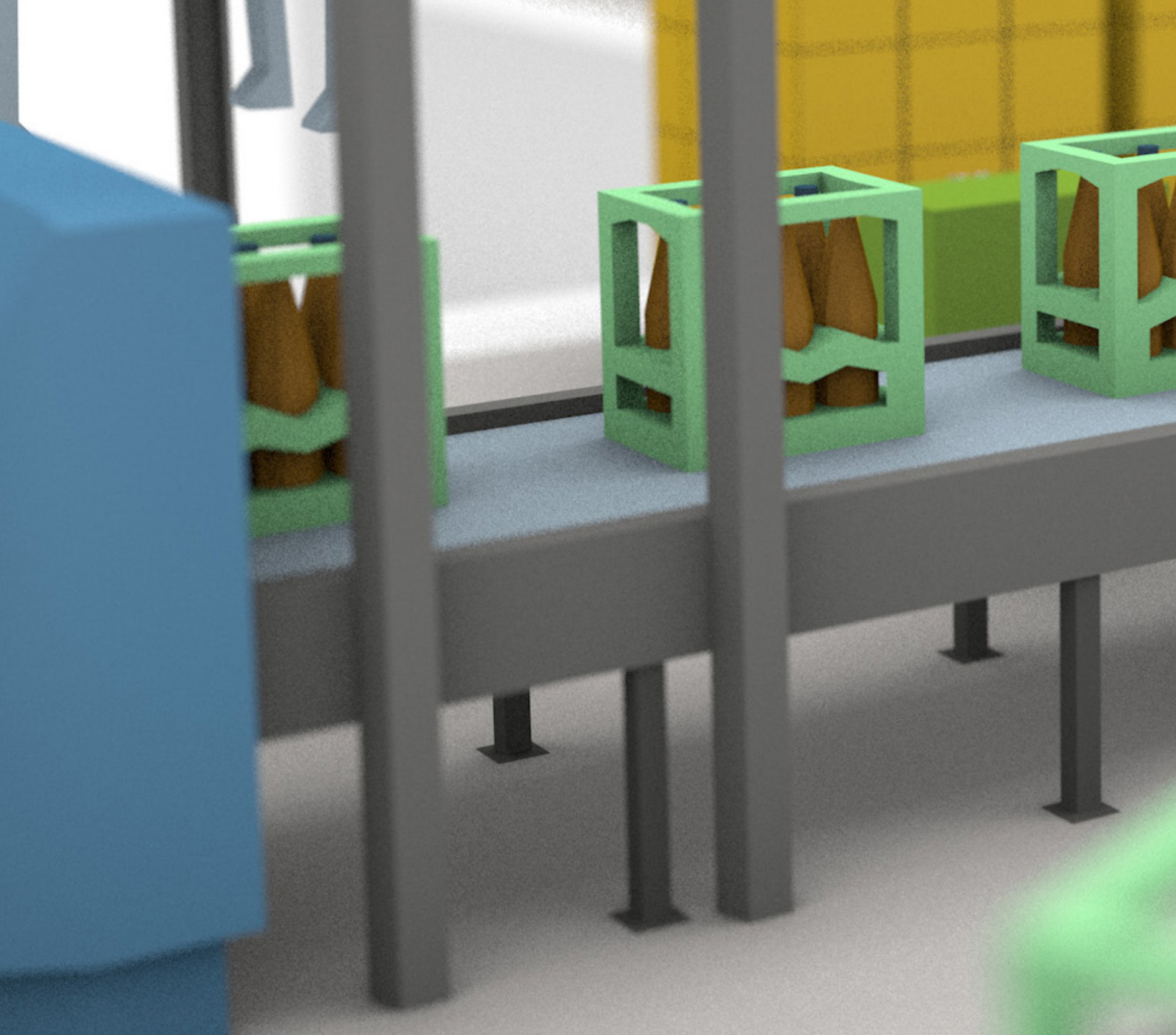
Field signal integration, horizontal and/or vertical networking, IT security, and modularization: "The essential characteristics of a smart factory from our point of view," explains Ulrich Hempen, Manager for Market Management Industry & Process at WAGO. "Of course, integration is performed step by step and according to need. The production managers know best which utility can b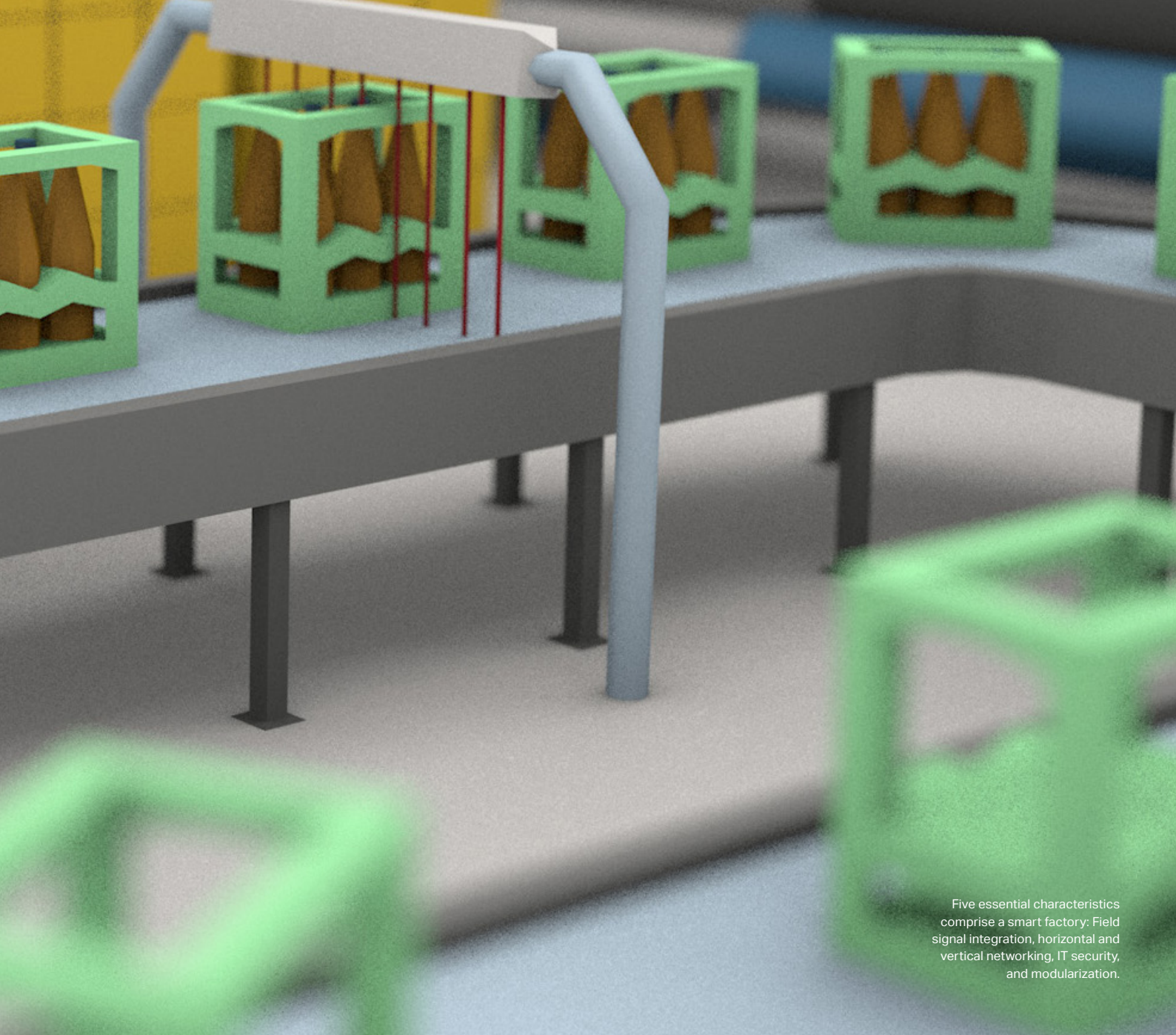e expected from digitization. We merely show how this transition can occur gradually using our technologies, including scalable expenses and predictable returns on investments."

1st Aspect: Sensor Integration

The initial pivot point of the digital transformation is to adapt the manufacturing processes using sensors. Sensors are already contained in production modules for automation; however, for a complete digital transformation of the physical production sequence, components that were previously considered as passive – like storage tanks, transfer belts, pipelines, or even the product itself – must also be digitized. In addition, objects subject to wear, like bearings in motors and drives, must also be included to complete the process. Digital adaptation requires that all production components, down to the smallest part in the manufacturing process, be included.

This is why the sensor system – and its integration – is one of the most important enablers for a digitized factory. "A complete digital process map is fundamental for enabling targeted direction of processes," states Hempen. The integration of this new variety of sensors, in the most cost-efficient way, is a basic pillar for the digitized factory and an enormous challenge, which WAGO has addressed. Because the WAGO-I/O-

SYSTEM 750 offers more than 500 I/O modules in a compact size with high scalability, WAGO can offer the market's most diverse system for sensor integration.

2nd Aspect: Horizontal Networking

Production processes are divided into multiple manufacturing steps. To create an optimal production process, all participating production islands must be networked. This also enables module-to module communication, so that production islands agree with one another and with the product (if necessary), without requiring higher-level production control processors. This horizontal networking applies beyond internal production processes to include external logistics for the manufacturing process. The supply of raw materials, and their disposal, should also be linked into logistics as needed.

The multiple communication lines in the WAGO PFC Controller meet the requirements for these applications, in order to operate multiple clients with different communication protocols from one node. Thus, communication with the upstream and downstream manufacturing islands can be performed from the controller; in addition, communication is possible with the product itself through *Bluetooth®*, and via Ethernet TCP/IP to the higher-level production guidance systems. This all occurs through separated communication paths in the controller. The WAGO Controller guarantees these multiple communication characteristics.

3rd Aspect: Vertical Networking

Cloud networking to servers openly available online – designated as the "public cloud' – generates some serious thought, as this

THAT IS THE DIGITAL FUTURE!

With WAGO to the Smart Factory

The digitization trend presents manufacturers with several challenges that must be resolved in the near term. WAGO has been working intensively on these very challenges, and has specific approaches to solutions, based on the technologies that are currently available and offer measurable added value to users.

Sensor Integration

Measurement data is fundamental for networking processes and directing them. WAGO supports you in obtaining valuable information from signals by using intelligent sensor-actuator integration. This can be used to set optimal utilization of systems, and for monitoring and further development. In addition, WAGO offers the world's most comprehensive I/O system with more than 500 I/O modules.

Cybersecurity

It is not enough to merely transmit data to the cloud, it must be secured from manipulation – this is WAGO's watchword. After all, production data is valuable, and must be specially protected. Due to security by design and a hardened Linux® operating system, WAGO controllers can repel cyber attacks. The WAGO Connectivity Portal also enables easy and secure transfer of all data over the Internet and is the ideal solution for plant access, remote maintenance, M2M, IoT and site-to-site networking.

Horizontal Networking

For Industry 4.0, networking of manufacturing islands is just as important to success as linking across system and facility boundaries. However, this trend requires a very flexible communication and control solution, which is precisely what WAGO offers with its I/O-System 750. More than 500 I/O modules, 60 controllers and 40 fieldbus couplings ensure smooth communication across the entire value creation process.
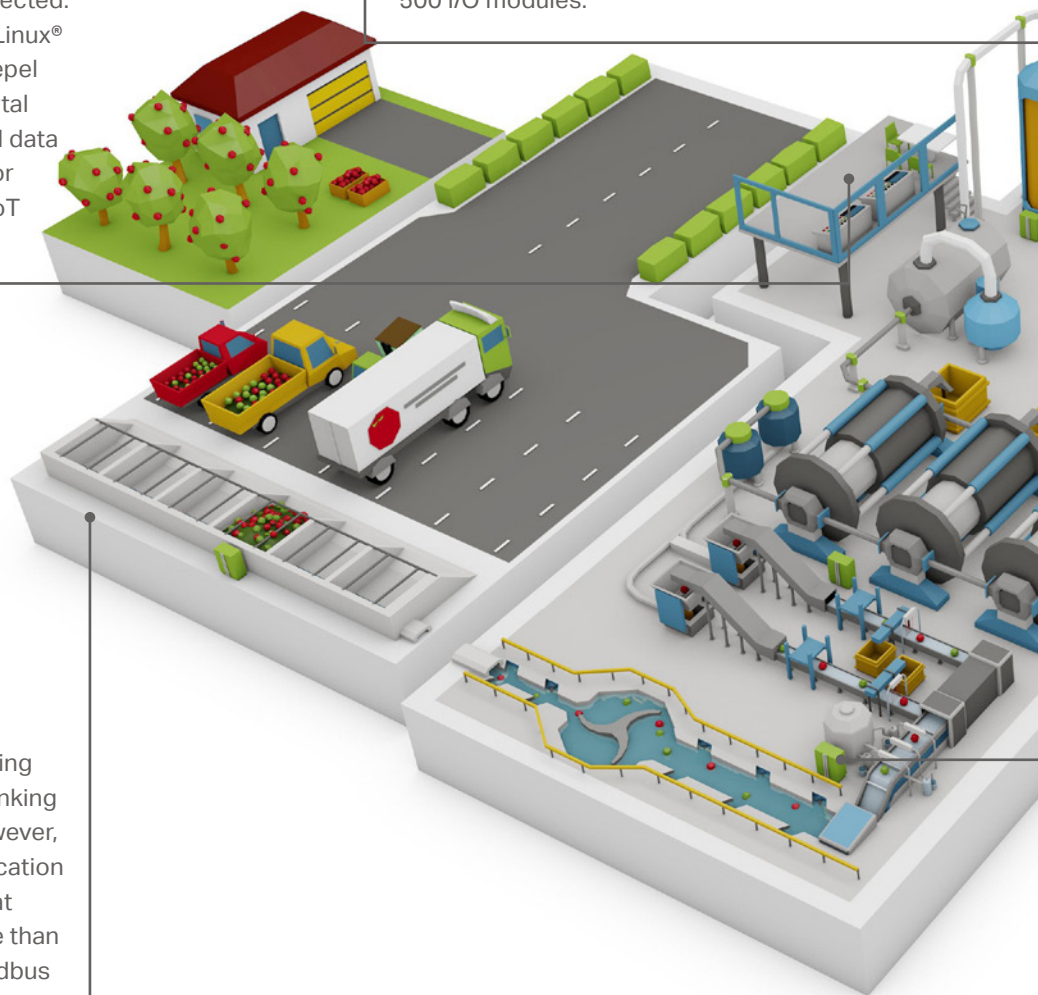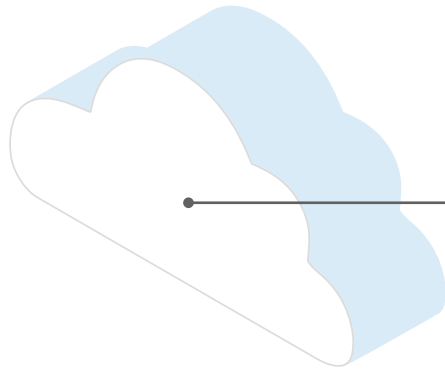
Adaptability

Adaptable production processes are the key to flexibility, efficiency and lot size 1. In order to realize these processes, system modules must be flexible and not tied to any one manufacturer. This places special demands on the automation system. WAGO has solved this with DIMA and has earned the German "Industry 4.0 Innovation Award" for it. DIMA MTP permits modules to be coupled and uncoupled within a control system – without any programming.

Cloud Connectivity

Cloud solutions offer a great deal of potential for the industry, especially with regard to plant availability and process optimization. Clouds link the real and digital worlds, and also simplify cross-site networking of global communications structures within companies. The controllers from WAGO'S PFC family provide a secure basis for data communication, from the field level up to the cloud.
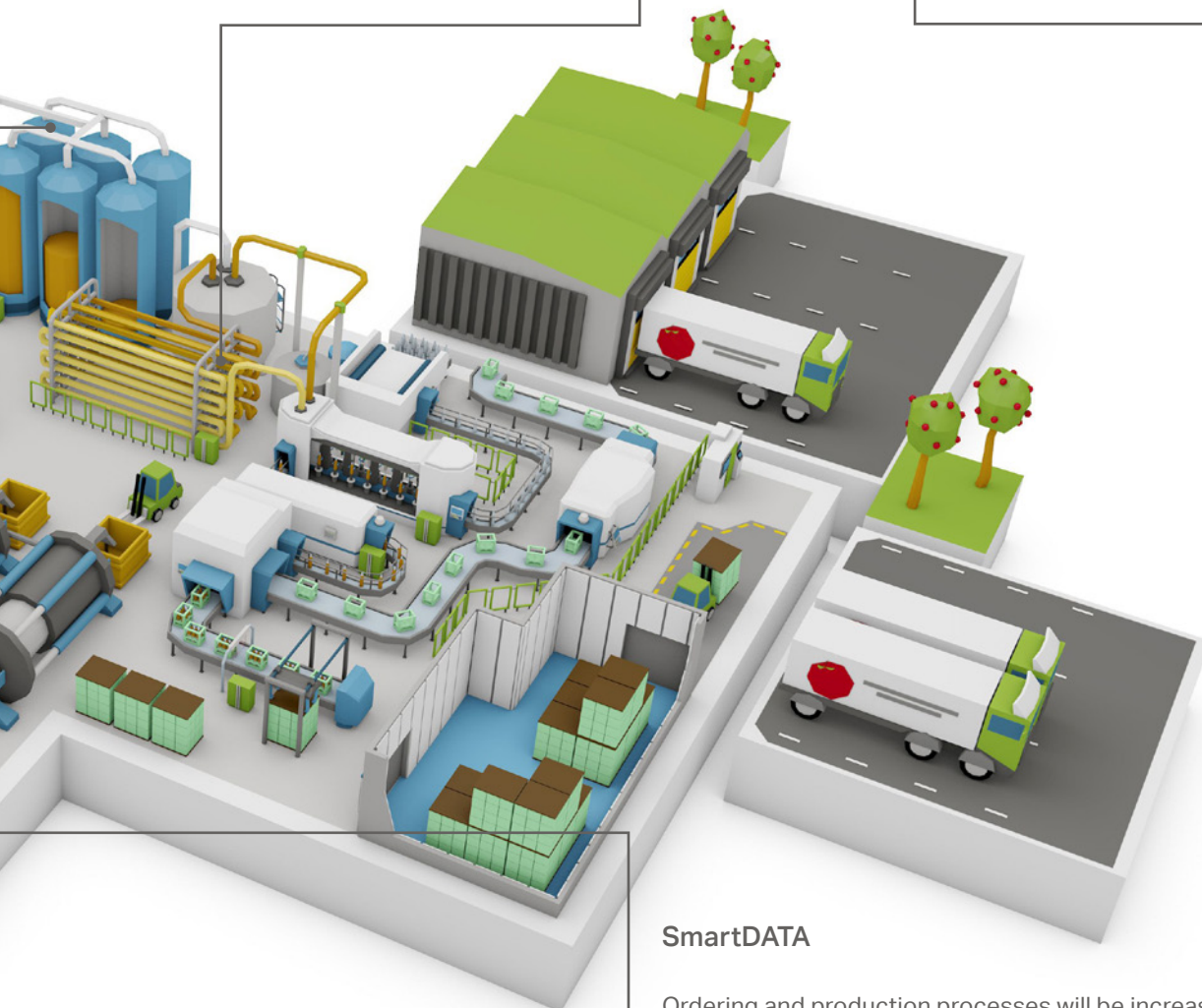
SmartDATA

Ordering and production processes will be increasingly digitized and automated in the industries of the future. The goals include consistency and data transparency along the entire value-added chain, reduced costs and time savings, while preventing unnecessary expenses. With its *smart*DATA engineering service, WAGO offers a solution that assists users from planning and designing through engineering up to testing and commissioning.

could open up access to the production process around the world under certain circumstances. In the vertical networking of the digitized factory, the distinction between open cloud applications and vertical networking to external manufacturing computers belonging to the company should be carefully maintained. Through protected accesses to one's own severs, for example, using VPN, https, and other individual encryption methods, and encrypted communication in private client server topologies, the Internet structure is merely employed as a network. This architecture, designated as the ''private cloud'', differs substantially from the public cloud in both its server landscape and in the server connection to publicly rented server landscapes.
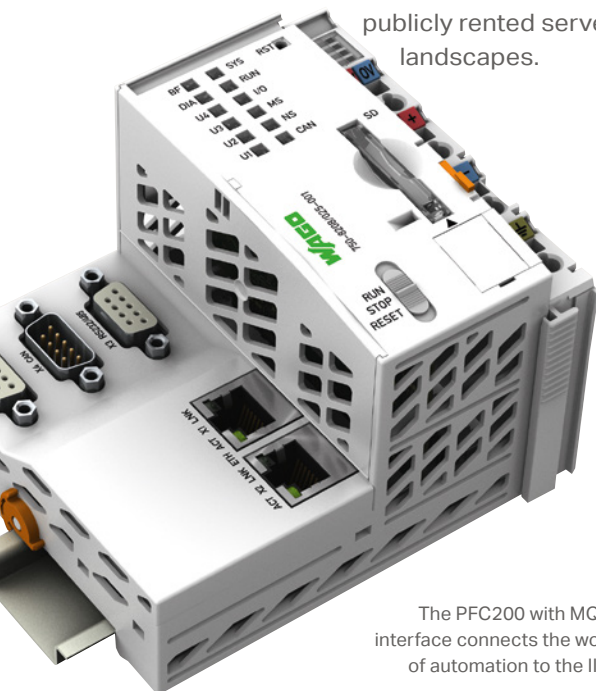
The PFC200 with MQTT interface connects the world of automation to the IIoT.

Regardless of whether the cloud is ''private'' or ''public,'' both cases concern the vertical linkage from the production model beyond corporate boundaries. For B-to-C firms, access to servers can be facilitated for end consumers, for example, enabling them to place an order directly at the production module. WAGO's controllers offer integrated remote access which converts to an IoT Gateway (Internet of Things Gateway). In addition to the actual controller, parallel communication protocols can be integrated through which access can be established. Physical access can occur via Ethernet or the mobile phone network, while logical access takes place via MQTT. As with horizontal networking, multiple communication access to the WAGO controller enables access by different clients to the controller. Status information, like run/stop, connection status, device information, and variables defined in the IEC program can thus be transmitted to the cloud and visualized. Variables can be defined via the program that can determine which will be transmitted to the cloud and which must be protected. This means that sensitive data does not leave the company.

The user determines whether the controller sends the data to major cloud providers, like Microsoft Azure, Amazon Web Services, or IBM Bluemix. With Cloud Data Control, WAGO also offers a solu-

tion that presents a link between the elements of the real and the digital worlds. It manages and monitors all WAGO PFC Controllers, their applications and data. In addition, connections to third-party solutions can be established, by using the MQTT protocol, among others, like a proprietary customer server with OPC UA communication.

4th Aspect: IT Security

When production data are detected and transmitted, IT security must play a substantial role. Production data are valuable, and require specific protection. A great deal of responsibility is transferred to the WAGO PFC Controllers and Couplers because of their multiple communication access capabilities. The controllers, with their Linux® operating system, have encryption standards according to TLS1.2 (SSH, FTPS, HTTPS, etc.) and offer onboard VPN functionality based on the strongSwan package, one of the secure communication solutions for Linux® operating systems. During communication with a PFC200, an encrypted LAN/WLAN connection can be established, and the contents of those interchanges can only be understood by the two endpoints.
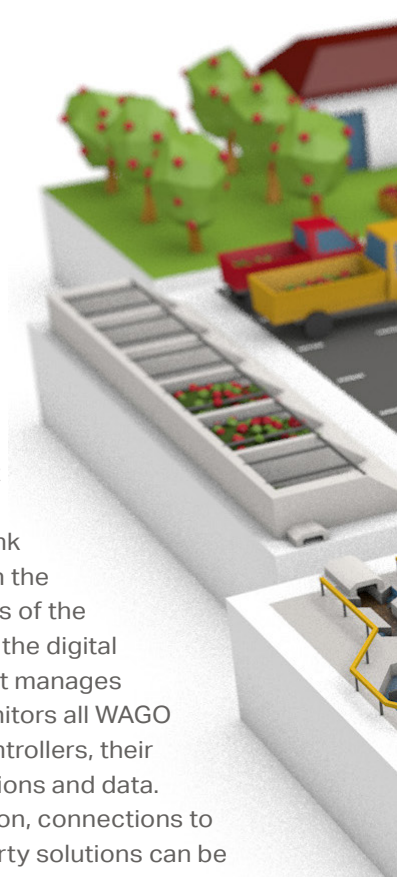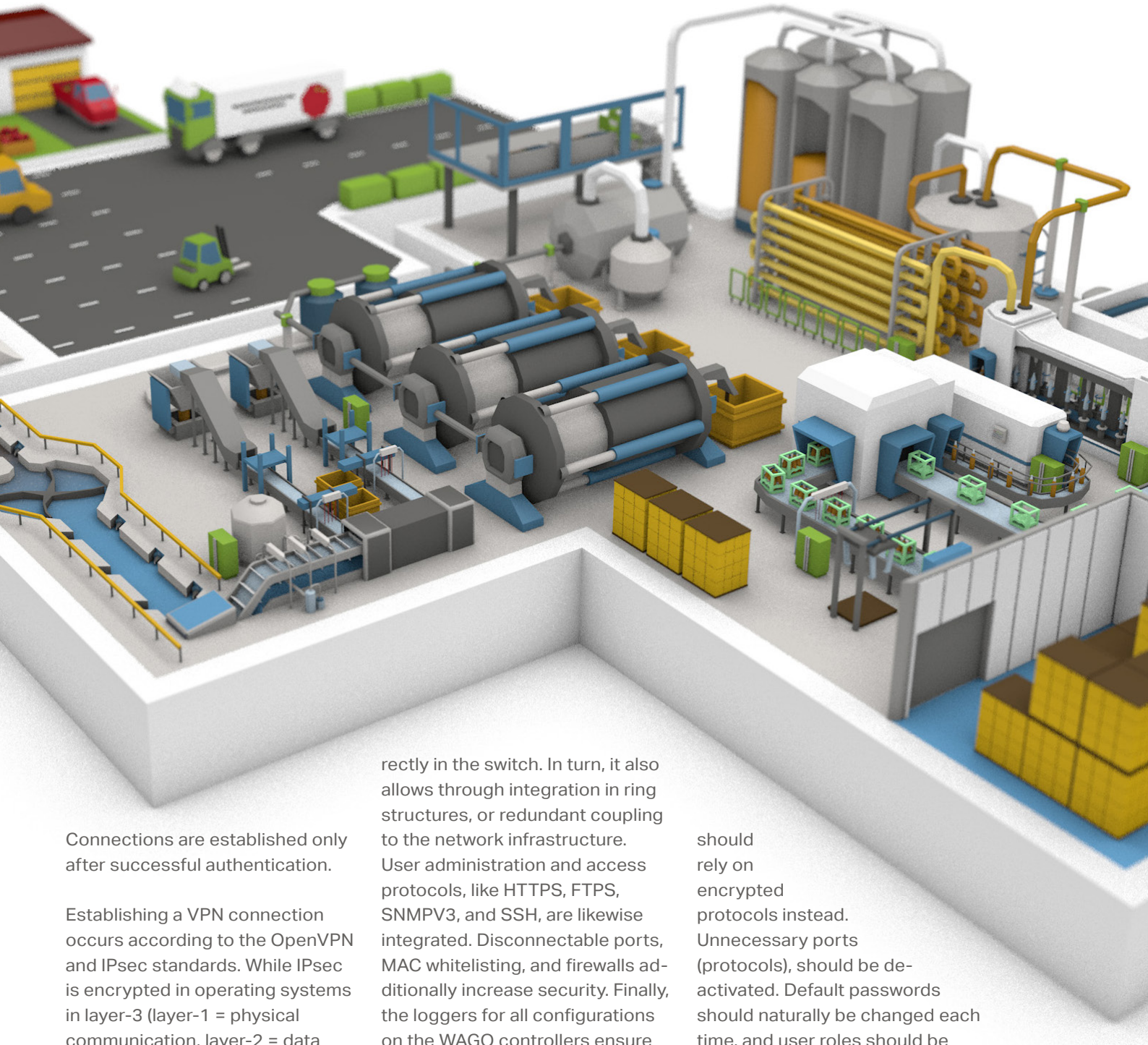
Connections are established only after successful authentication.

Establishing a VPN connection occurs according to the OpenVPN and IPsec standards. While IPsec is encrypted in operating systems in layer-3 (layer-1 = physical communication, layer-2 = data layer link), OpenVPN ensures data integrity at the application level (layer-7). This results in communication connections between the controllers and network access points that cannot be bugged or manipulated by third parties. WAGO's controllers from the PFC100/200 family include an integrated managed switch that can be used to implement additional lines or redundant ETHERNET connections. This also enables the broadband limit function di-

rectly in the switch. In turn, it also allows through integration in ring structures, or redundant coupling to the network infrastructure. User administration and access protocols, like HTTPS, FTPS, SNMPV3, and SSH, are likewise integrated. Disconnectable ports, MAC whitelisting, and firewalls additionally increase security. Finally, the loggers for all configurations on the WAGO controllers ensure additional security.

The PFC100/PFC200 are characterized by a cross-platform real-time Linux® system, which is available as an open-source operating system that can be scaled, updated and supports tools such as Rsync. Basically, the user should be able to take precautions in less critical applications: Unsecured protocols, like Telnet, http, FTP, or SNMP can be avoided for critical applications. These

should rely on encrypted protocols instead. Unnecessary ports (protocols), should be deactivated. Default passwords should naturally be changed each time, and user roles should be assigned.

5th Aspect: Modularity

Production must react with flexiblity and versatility to challenges incurred by increasingly shorter product life cycles, paired with significantly lower batch numbers down to lot size 1, without increasing manufacturing costs. The necessary versatility can only be created by modularity in the production process. This applies

The possibilities that arise from digitization and networking within a factory are diverse – from optimal throughput of processes, through conservation of resources, multiple usages of computer-generated data, and the versatility of production, up to the possibility for monitoring systems over their entire lifecycle after shipment to third parties.

to both production modules, and automation across the entire manufacturing process. This is why WAGO introduced the DIMA MTP method in 2015, which is currently on a path to becoming the international standard.

Content forms the standard for interfaces between the manufacturing modules and a higher-level production control processor. Thanks to standardization, manufacturing modules can be replaced without adaptation in the production control processor. This is comparable to exchanging the printer used by a PC, which the user can immediately activate due to standardized printer drivers. DIMA MTP likewise uses a software driver for the production modules: The "MTP – Module

Type Package". Like a driver for a printer, the MTP contains a digital description for the manufacturing module, and thus the virtual description of a system that is physically available. The MTP describes the functions of the production module, its visual representation in the production control processor, diagnostic information, and technical data. It is designed in Automation ML, and is generated by the PLC software program in the production module. At WAGO, it is possible to generate the MTP as easily as pressing a button due to the programming behind the WAGO *e!*COCKPIT Engineering tool.

The MTP is thus an important component, embedded in the DIMA method for solving the

demands made by Industry 4.0 for modular systems that are not merely modularly constructed, but also modularly automated. This forms an essential foundation for the autonomous, self-monitoring factory. System modules can thus be flexibly combined with one another independent of manufacturer, which then forms the basis for even more flexibility and versatility.

TEXT ULRICH HEMPEN, EVA KOCH-BANHOLZER | WAGO

PHOTO WAGO

Conclusion

Digitization in production is a necessary development that brings stability and increases added value – it is also becoming more important with increasing international competition and rising product customization. The digital factory – smart factory – is presented as a reference architectural model of Industry 4.0 by ZVEI, and describes the essential challenges. WAGO responds to these challenges with solutions for sensor integration, horizontal and vertical networking, IT security, and modularity.

RELIABLE PROTECTION AND COMMUNICATION

Two new electronic circuit breakers (ECBs) with IO-Link:
WAGO's highly communicative four- and eight-channel *EPSITRON®*
Modules provide maximum safety in a minimal footprint.

The *EPSITRON®* ECBs within the WAGO 787 Series Power Supply System reliably and precisely protect applications with 24 VDC power supplies. The latest in WAGO's extensive portfolio of ECBs, these new four- and eight-channel models feature IO-Link integration for fast, reliable communication.

Fieldbus connection via standard IO-Link clears the way for:

- Convenient status monitoring
- Remote parameter setting – for easy parameterization after replacement
- Easy integration of the ECBs into higher-level control systems

Precise, Compact and Customizable

WAGO's new four- and eight-channel ECBs trip reliably according to EN 60204-1 under adverse conditions. The devices are significantly thinner than equivalent conventional circuit breakers – a real plus for compact installations, especially those in confined control cabinets. The ability to set nominal currents individually by channel, and the read off of individual actual current values makes custom current monitoring possible. Furthermore, the high switch-on capacity reduces the risk of false tripping due to high inrush currents. With IO-Link onboard, WAGO's new ECBs become part of the communication linkage to the control level – with all the advantages that telecontrol technology offers.

At a Glance:

- Fieldbus communication with IO-Link for status monitoring
- Remote parameter setting option
- Slender design for compact installation
- Four- and eight-channel version for 24 VDC voltage
- Nominal currents can be set individually by channel

Fast and reliable communication using I/O-Link is also integrated into the new electronic circuit breakers.

Connected Factory

SUCCESSFULLY NETWORKED

Data in the cloud, added value in the company: In a series of presentations about the "Connected Factory", Microsoft and WAGO demonstrated how companies can profit when they combine their production and systems data in a cloud.

Thorsten Cleve, Director of Manufacturing Industry at Microsoft Germany, sums up the development toward Industry 4.0 and the Connected Factory: "In the digital transformation of today, we no longer discuss 'if', but 'how'". The integration of production chains, logistics chains and value-added chains provides industrial companies with greater agility, ensures more efficient processes, creates security, and facilitates greater customer focus.

Cleve and other experts provided answers to questions about "how to" at the Microsoft Connected Factory lecture series. The event was held at the end of last year at the software company's new German headquarters. The core concerns in the design of a networked factory focus on recording, integrating, and evaluating production and other data. These were good reasons for Microsoft and WAGO to partner in this event. WAGO combines automation technology and IT, thus creating a link, with their products and solutions, that connects the physical world of machines, systems, and devices on the one hand to the digital sphere of data and analysis on the other.

In the lectures, experts from Microsoft and WAGO provided information to the 100 participants from industrial and consulting firms about how corporations can network their data to generate added value. In addition, the participants

Max Morwind, Technology Advisor IoT at Microsoft Germany, illustrated the added value offered by digitized production using cloud solutions.

had the opportunity to use their newly acquired knowledge in a hands-on workshop led by experts from WAGO.

"Signals are recorded where they are generated"

One focal point of the lecture series was on cloud solutions, which WAGO can provide to support clients during the digital transformation. In his opening presentation, Jürgen Pfeifer, Account Manager Automation at WAGO, described the challenges many companies currently face: "Industrial plants often maintain a very heterogeneous pool of equipment. How do you get data from these systems? How do you combine them? In short: How do you create a Connected Factory?" The answer lies in the PFC family of controllers from WAGO. These controllers collect data from the field level, encrypt them using TLS, and transmit the encrypted data to Microsoft's Azure Cloud using the MQTT protocol. There data can be aggregated and evaluated. "The signals are recorded where they are generated. This eliminates di-

versions and software engineering expenses," according to Pfeifer. The WAGO PFC is Azure certified. Pfeifer continues, "Due to the variety of protocols and standards that the PFC supports, facilities are essentially not subjected to limitations on connecting systems and equipment."

The WAGO Cloud Data Control functions as the user interface for customers – this is an out-of-the-box application on Azure, which clients can use through a standard web browser, regardless of location, to access functions like controller, project, and user management, system monitoring, or report generation. "Any PLC expert can handle this immediately. However, you don't have to be an IT specialist in order to use it," promised Pfeifer. His advice to the audience was to, "Just try it out!"

Two Versions of the Cloud

Frank Schmid, Head of Business System Solutions at M&M Software, a WAGO subsidiary, also emphasized how user friendly the software

Thorsten Cleve, Director of Manufacturing Industry for Microsoft Germany, touted the thoroughly networked factory. According to Cleve, this provides companies with greater agility, ensures more efficient processes, creates security, and facilitates greater customer focus.

is. "Configuring the connection to Azure is performed using the local web server. Any PLC programmer can do this," stated Schmid.

WAGO offers its Cloud in two versions: The first represents as "Software as a Service" (SaaS), in which WAGO takes on the role of cloud operator. Customers connect their WAGO controllers to the cloud and independently create their own accounts and projects. The second allows customers the possibility of creating their own cloud with WAGO. "We offer this proposal to companies that have a lot of systems to link in, and who want to configure the cloud to their own business purposes. In contrast, the SaaS model is aimed at companies that want to quickly start profiting from the cloud at low cost," explained Schmid.

Security in the Cloud

Microsoft Manager Thorsten Cleve also discussed some of the higher-level goals that industrial compa-

nies can address using digital transformation. "This primarily concerns thoroughly understanding what the customer wants more quickly, and then translating this information into one's own processes," summarized Cleve. Max Morwind, Technology Advisor IoT at Microsoft Germany, used specific numbers to emphasize the added value offered by digitized production using cloud solutions. For example, industrial plants could increase their productivity by an average of 17 to 20 percent by designing a Smart Factory. However, to date a mere seven percent of these companies have implemented real-time solutions for monitoring the entire production process.

What is preventing corporations from using the cloud? One essential reason, as it became clear in discussions with participants during sessions and breaks, is a concern about data security. Dr. Holger Krenn, an expert from Microsoft, referenced the extremely high security standards of the Azure cloud. The IT giant employs 5,000

security experts, whose sole job is to ensure the security of Microsoft's systems and applications. Schmid also stressed the high priority of security in the WAGO cloud. Among other points, the expert referred to the encryption of incoming and outgoing data traffic, and emphasized that Azure services and resources are not shared between customers.

**TEXT** RALPH DIERMANN
PHOTO RALPH DIERMANN

WAGO IOT CONTROLLERS NOW INCLUDE MICROSOFT AZURE CERTIFICATION

WAGO's PFC100 and PFC200 IoT Controllers are now Microsoft Azure certified. This certification guarantees users that the systems work optimally with the Azure cloud, allowing IoT projects to be easily and safely implemented.

With WAGO Cloud Data Control and both PFC100/PFC200 IoT Controllers, WAGO offers a solution that links elements from the real and digital worlds. WAGO Cloud Data Control manages and monitors all WAGO Controllers, as well as their applications and data. WAGO's cloud service is hosted at Microsoft Azure; certification ensures smooth communication. The MQTT protocol provides a reliable and secure connection with TLS encryption. Microsoft Azure is highly scalable in computing power, data storage, transactions, availability, and security standards. It offers a large number of services and tools to provide an optimal foundation for implementing IoT applications.

The user accesses cloud service via web portal that provides standard functions including: project, controller, and user management, controller status monitoring, alarm functions and email messaging. A dashboard displays text, tables, diagrams, display elements and command buttons for seamless and intuitive operation. For customized solutions, the REST or OPC UA interface is used, for example, in energy monitoring or predictive maintenance applications. These IoT applications can be quickly and easily implemented using both certified controllers and WAGO Cloud Data Control. Of course, the user is not bound by WAGO's cloud solution. The MQTT protocol can also be used with the IoT controllers to create custom solutions using Microsoft Azure.
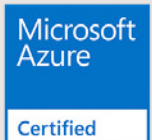
CLOUD CHAMPIONS!

# Initially, it was a simple idea, but such an ingenious one:

In 2017, WAGO announced the first unofficial Cloud Championship to vote on the best cloud solutions for smart automation applications. In order to participate in this ideas competition, the application had to be based on a PFC100 or PFC200 Controller, capable of IoT connectivity, solve a specific user problem, and present realistic usage for automation technology.

Sixteen individual and team applications were received – developers, engineers, and IT specialists from all over Germany delivered smart pitches. They presented their ideas before a high-caliber WAGO jury consisting of product developers, innovation leaders, and market specialists.

The prizes included 6,000 euros in cash and an attractive IoT starter kit, which the winner could use to develop models into prototypes to present at the SPS/IPC/Drives 2017. Tom Riebe, from TAKRAF, an international supplier of devices for surface mining and bulk materials handling that is headquartered in Leipzig, received the crown of Cloud Champion 2017. A team of computer science students at Furtwangen University, and Christian Müller from the IDEAS engineering consulting firm, joined him on the winners' podium. More about the victors on pages 28 to 41.

TEXT ALBERTO ALONSO MALO | WAGO
PHOTO WAGO
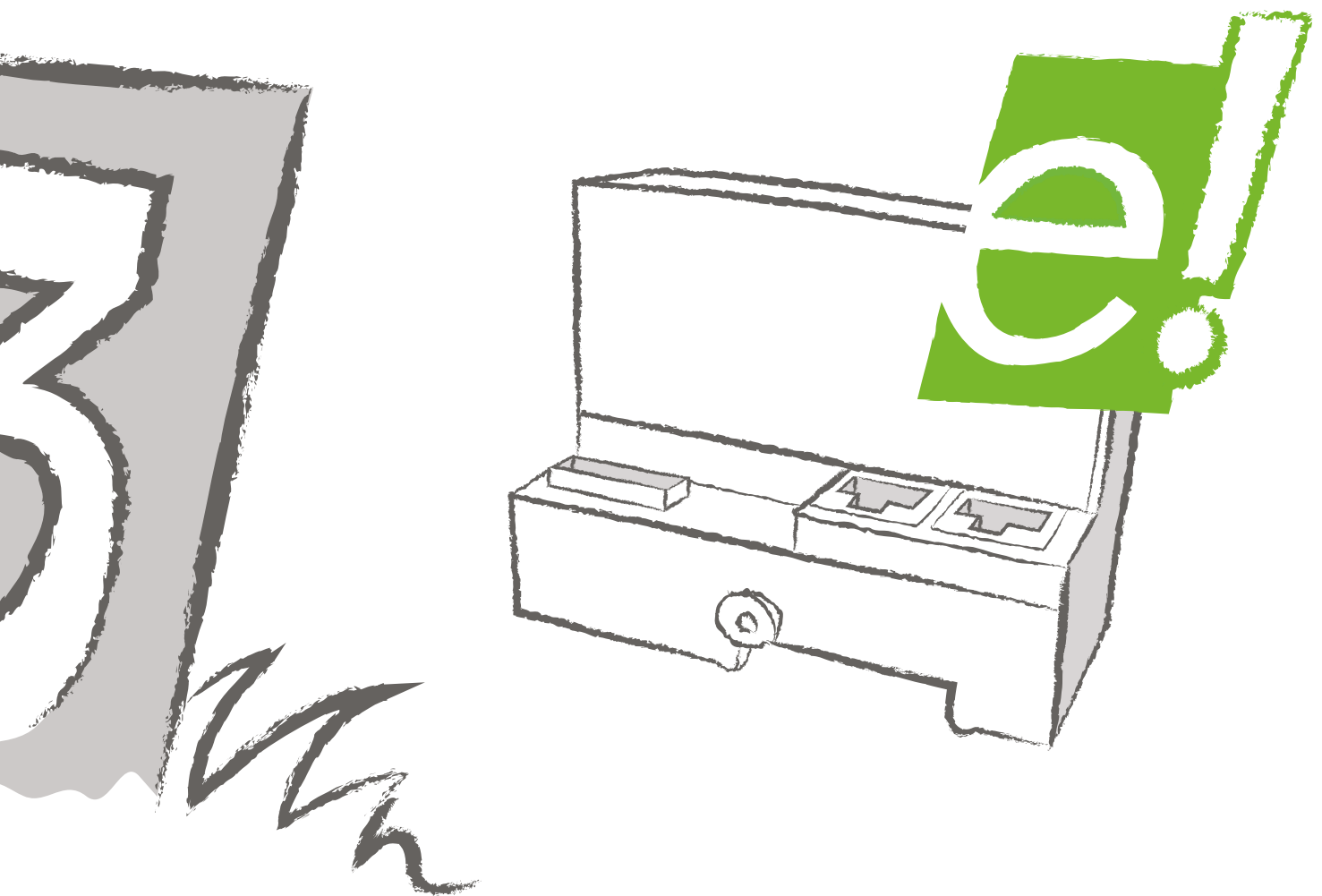
Cloud Championship project
manager Anja Jakimenko, jury
member Dr. Thomas Holm,
and champion Tom Riebe from
TAKRAF (right)

Tom Riebe from TAKRAF GmbH – WAGO Cloud Champion 2017

OPERATIONAL DATA RECORDING AND INFORMATION RETRIEVAL IN SURFACE MINING

TAKRAF GmbH is global supplier of continuous conveying technology. The company, headquartered in Leipzig, delivers its machines to mining regions worldwide, including Chile, Peru, Brazil, India, Russia, and Guinea. The installation sites for the systems are often remote and difficult to reach. "Different, and often new, challenges are presented to our equipment in each project. Despite progress in digitization and networking, we do not encounter the same level of development in network infrastructures around the world," emphasizes Tom Riebe, a trainee in electronics and instrumentation

at TAKRAF. In many cases, however, a connection can be established over the mobile phone network, which is an advantage that Riebe incorporated into his concept.

An Idea Still in Development

The basis for the idea was creating decentralized access points to record data from the globally distributed TAKRAF systems. A link to cloud portals is thus possible, and recorded data can be centrally evaluated. The existing, locally installed automation

technology, which is necessary for safe operation of the systems, remains largely untouched. The solution's goal: Have the locally-collected data automatically evaluated by specialists in the home office. The results could then be used by operators, for example, to evaluate system states or optimize operating modes, to substantially increase the systems' lifecycles and availability. Implementing

phase – therefore, he cautions against high market expectations and is currently hesitant to reveal specific technical details. "My proposed solution initially functions both for the internal presentation of possible applications of the WAGO Cloud and in support of internal TAKRAF brainstorming." For productive use in a mine's rough environment, for example, additional development is required – this

»My proposed solution initially functions both for the internal presentation of possible applications of the WAGO Cloud and in support of internal TAKRAF brainstorming.«

benchmarks from comparable systems and subsequent recommendations for the system operators could conceivably aid in optimizing operations. Physically linking the systems to the WAGO Cloud Data Control can be easily performed using the IoT-capable WAGO PFC Controller.

"Traditional visualization technology and process control systems already exist in our equipment; in addition, remote access possibilities are also often installed," according to Riebe. However, the ability to obtain access to process data, from outside of the location and without a direct connection to the controller, simply does not often exist. With the introduction of cloud connectivity, TAKRAF could differentiate itself from competitors in systems engineering in the mining sector, and offer additional added value to the customer, for example, in the form of increased system availability. Riebe places great value on the potential of his approach. The current development remains in a very early

includes clarifying contractual and legal questions. However, the experts all agreed that cloud solutions will be implemented to obtain information in the mining sector." For the Cloud Championship jury, this vision was sufficient to declare Tom Riebe's presentation a champion.

TEXT ALBERTO ALONSO MALO | WAGO

PHOTO WAGO

Jury Assessment of Tom Riebe/TAKRAF GmbH: Alternative Visualization and Control Possibilities in Surface Mining

We have ranked Tom Riebe's industrial application first because it represents an actual, and very elegant, application that aligns with WAGO's strategic focus. It has a high possibility for implementation. We found the conceptual connections to be quite intelligent in pairing the traditional heavy steel industry with the sophisticated premise of cloud communication and analysis to increase the efficiency of heavy machinery and reduce downtime.

Interview with Cloud Champion Tom Riebe

Tom Riebe is a trainee in electrical systems and instrumentation at TAKRAF GmbH, located in Leipzig. The company is involved in surface mining and bulk materials handling worldwide. Another facility is located in Lauchhammer, in addition to subsidiaries around the world.

Why keep the sector waiting for your idea?

» Opening surface mines and implementing the associated conveyor projects can take several years. A typical project completion timeline, from design to commissioning of an entire system, can be one to three years. This length hinders the introduction of new technology. That is certainly one reason why novel, digital innovations, usually consolidated under the term "Industry 4.0", are relatively rare.

In the rather conservative mining sector, innovative solutions only gain acceptance when a customer not only clearly benefits from their implementation, but the innovation offers tangible financial benefits. By maintaining contact with our customers and systems via data-based services, we see a major chance for linking our knowledge with the experience of the operators to create a win-win situation. «

What specific utility do you see for your customers?

» In our view, there are many advantages for the customers: Mine and system operators from different areas – specifically the decision-makers – obtain a clear overview of the current KPIs for the equipment. This transparency allows them to follow the data deep into the systems to better identify possibilities for optimization. They can also profit from the comprehensive expertise of TAKRAF engineers from various development sectors by employing the cloud solution.
The cloud application could be developed and operated in parallel to existing automation structures, and represents additional functionality. This meets the safety-minded and cost-optimized approach of mine operators halfway. The system could also be rolled out in phases for existing systems. The mine operators would not have to provide large initial investments, and the existing systems would not be subject to expensive retrofitting. «

Where do you see advantages in working with cloud connectivity solutions from WAGO?

» Very different requirements for selecting the control hardware exist as a result of the systems being delivered to many different customers on different continents. Therefore, we do not have the

luxury of standardization. WAGO's PFC family offers the major advantage of providing interfaces to all current fieldbus systems, enabling connection to PLC hardware from diverse manufacturers. The data arrive from different sources; however, they are collected centrally in the WAGO Cloud, and are thus available for centralized use. **«**

Furtwangen University – First Runner-Up WAGO Cloud Champion 2017

THE PERFECT WINE SPRITZER

Pour water in the glass, add a splash of white wine, an ice cube or two – and this alcoholic thirst-quencher is ready. When considered soberly, mixing a white wine spritzer is hardly a gastronomic challenge. However, when customers can compose a drink according to their own tastes using a cellphone app, and can personally select the glassware, then a great deal of innovative spirit standing behind it. The "Wish 4.0" vending machine, developed by a group of computer science students at Furtwangen University, hit the right note with the Cloud Championship

jury. The idea implements many concepts from digitized product manufacturing by using a WAGO IoT PFC Controller and cloud connectivity so that wine spritzers created this way receive an extra shot of individuality.

Industry 4.0 is behind the Wish Design

Reacting quickly and flexibly to orders, and thereby economically manufacturing truly custom items: "Wish 4.0 explores the possibilities and boundaries of cloud manufacturing. We wanted

(from left) Dirk Hölscher, Professor Christoph Reich, Timo Bayer, and Philipp Ruf from the Institute for Cloud-Computing and IT Security at Furtwangen University, drink a toast to their Cloud Championship idea: the Wish 4.0 wine spritzer vending machine.

to implement and exemplify typical Industry 4.0 concepts in one device for our competition entry," explains Christoph Reich, professor at the Institute for Cloud Computing and IT Security at Furtwangen University. Together with a seven-member team, he developed a prototype that integrates aspects that are generally applicable to Industry 4.0, like individualization of products, process optimization and automation, condition monitoring, cloud control, smart logistics, and supply chain compliance. The scientific innovation included in the concept: Neural networks recognize glass types and supply the correct volume for the glass.

Phase I – "Acceptance of Bid"

4.0 Concept: Personalization

Users have the opportunity to customize a white wine spritzer to their exact requests. This includes personalized label creation through a publicly available web interface. The drink is configured as desired by setting mixing ratios – this includes a selection between two types of wine, water and juice. In addition, the user can select an image, add a short, personalized message if desired, and upload it for use as a label. When the label is printed, it also includes a barcode containing all relevant information, with an 8-figure ID provided for security that is assigned to the order and allows tracking of the current status. The similarity to Industry 4.0 is the ability to track a product at each stage of production.

4.0 Concept: Compliance

Before the order is accepted, the system checks that the label information conforms to ethical and community standards to prevent the propagation of epithets, insults and derogatory speech or images. Google Cloud Vision API is used as a reference. The verification process is initiated by implementing a REST interface using Java; prohibited images and statements are stored on a blacklist. Machine learning algorithms available from Google manage the analysis – in an ethics violation occurs, the user receives a message that the order could not be successfully completed. If Vision API accepts the order, then the user receives a unique iden-

tification code, which allows them to print the label and apply it to their glass.

Phase II – Production

4.0 Concept: Cloud Controller

All higher-level control commands for Wish 4.0 are completed in the cloud – the relevant information is compiled in a table and written in a self-managed open stack cloud. The university team initially relied on a proprietary cloud architecture: A database with all of the orders is stored on the ''spritzerVM'' server. spritzerVM communicates in turn with WAGO Cloud Data Control, which is the link between the elements of the real and digital worlds. The WAGO cloud forwards the information to the WAGO IoT PFC Controller, which executes the commands, for example, that operate the relays that control the magnetic valves for the sensors.

4.0 Concepts: Smart Logistics & Visual Quality Management

The actual process of wine dispensing starts when users place their labeled glasses in the scanning chamber where a small camera is installed. A proximity sensor detects the approach and transmits a signal to the PLC. This communicates to a Raspberry Pi unit, which serves as an intermediary picture processor, that the glass is ready. This triggers causes the Raspberry Pi unit to record the image, encode the integrated barcode on the label, write this information into the spritzerVM database, and trigger a REST Call to identify the glass and calculate the volume. The image of the glass is analyzed using neural networks from the most recent generation (deep convolutional neural networks) – the system can learn the general features of different glasses in order to distinguish them. A template is generated from each image to map the edges of the glass, making it possible to mathematically calculate the volume. If a glass is detected with a predefined probability (70% for the Wish 4.0), then the WAGO Cloud provides this information, together with the instructions about the desired mixture, to the filling module. Before triggering the valves, the glass is positioned at the filling station using a rotating plate. The cloud communicates the number of degrees of rotation to a
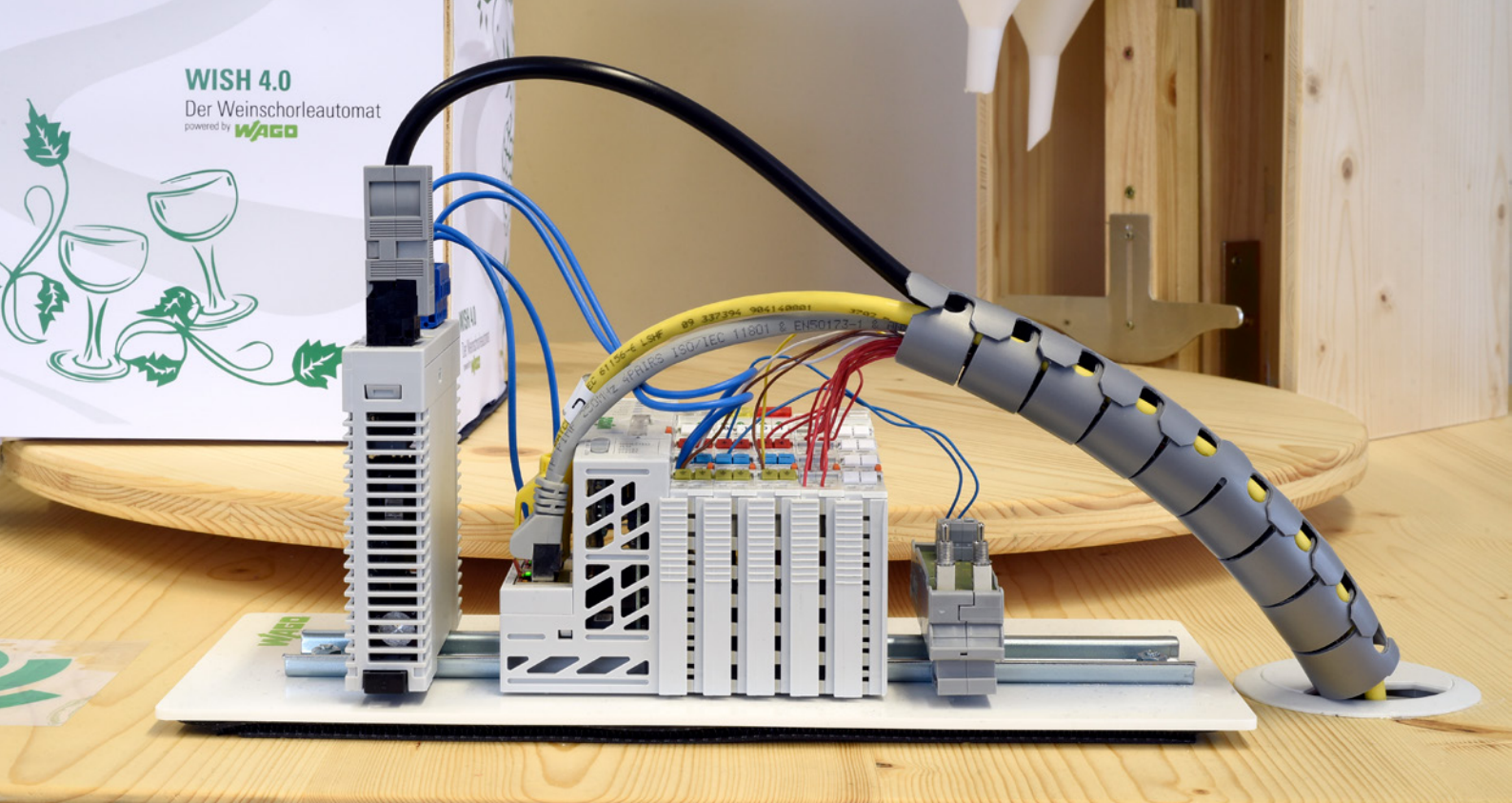
Wish 4.0 implements many concepts from digitized product manufacturing by using a WAGO IoT PFC Controller and a cloud connection.

motor controller for this. After a successful filling, the glass is conveyed back to the discharge position.

4.0 Concept: Process Optimization & Condition Monitoring

The Wish 4.0 includes two filling machines, each with four tanks for the wine spritzer ingredients. Doubling up on equipment enables parallel filling and also supports process optimization – the ingredient container can be flexibly selected depending on use and according to need. Sensors evaluate information about this, and forward the data to the cloud to continuously monitor the state of the two filling systems.

Thus, the machine can issue an early warning, if one of the tanks needs refilling, for example, or whether the tanks will be flushed, or the current state of the individual magnetic valves.

TEXT ALBERTO ALONSO MALO | WAGO

PHOTO THOMAS KUNZ | VOR-ORT-FOTO.DE

Jury Assessment of Furtwangen University: Wish 4.0

We consider the invention from Furtwangen University to be a classic example of an approach that is currently receiving a lot of focus: Extremely agile product development. What we found to be most compelling is the high level of creativity and the strong concept of teamwork shown by the group. While it is indeed a work in progress, we are highly interested in observing how quickly they brought the idea from a concept to an actual prototype. WAGO can learn from how startups approach product development – an experience that's far from our own. It's also worthwhile to learn about how they approach potential customers with a prototype that is still in the embryonic stage, and how quickly they then refine and develop the product with these customers. The idea in the chosen methodology is conceptually interesting and it shows commitment to the future.

Good Insights into the World of WAGO

Prospective doctoral candidates, Phillip Ruf and Timo Bayer, have concluded their studies at the Institute for Cloud Computing and IT Security at Furtwangen University. They are part of the seven-member team that won second place at the WAGO Cloud Championship with the prototype of an app-controlled wine spritzer vending machine.

What made you decide to participate in the WAGO Cloud Championship?

» It was primarily due to connections we have at the software company, M&M from St. Georgen im Schwarzwald. Engineers there mentor many of the semester projects at our university. They asked if we wanted to participate in the WAGO Cloud Championship. We accepted the challenge – even though we only had one month to deliver. «

What type of previous experience with cloud manufacturing did you have?

» At our institute for applied research, different research projects are created, including one from the Industry 4.0 sector, so the competition fits in really well with the topics of study. Another one of our wishes was to get the name of Furtwangen University out into the public in another context. It quickly became clear that we wanted to design something from the field of industrial automation. It was also a good chance for us to become more familiar with WAGO devices. Of course, we knew about WAGO connection modules, but we had not worked with the Cloud Gateway. By using the starter kit that WAGO provided, we gained excellent insight into the products, which led to us using a similar WAGO product for another ongoing research project at our university. That project is called Halfback – Highly Available Smart Factories in the Cloud. «

Timo Bayer and his colleagues developed the prototype for the Wish 4.0 in just one month. They were able to quickly familiarize themselves with the WAGO products.

Auf die Freundschaft!

The process for wine dispensing starts when the user sets a labeled glass into the scanning chamber, which includes a small camera. A proximity sensor detects the approach and transmits a signal to the PLC.

It appears that your team could work well with the IoT PFC Controller and the WAGO Cloud ...

» Once you have used WAGO material and understand the interfaces, such as how the internal communication functions between the controller and the cloud, then it becomes an excellent tool. A PLC is nothing new; however, the added value in our context is the connection to and synchronization with the cloud gateway. This was very productive for our application, because we could integrate cloud connections without much technical expense. «

How did the "WAGO tools" get used in the Wish 4.0?

» We control a lot of components and make calculations using the WAGO Cloud. For example, the controller for the on-site relays and all of the equipment is connected to our calculations in the cloud. This in turn provided an easy possibility for switching the individual ports using REST CALLS, as well as reading out inputs. And it was, of course, also possible to optimize the entire process to make it more elegant. The tasks undertaken by the Arduino and Raspberry Pi could also have been assumed by the WAGO Controller. However, we lacked the time and the necessary modules for that. «

What are your future plans for the Wish 4.0 prototype?

» Wish 4.0 is going to be further refined as an ongoing research project at our university. In the next step, we'll develop and refine all of the 4.0 concepts that we used. The processes could be further optimized and expanded to be more

nuanced, more precise, and more complex. The changes to the prototype are almost exclusively related to the software, and should be solved on the software side. It is conceivable, for example, that we may include additional sensors, in order to measure the state of the equipment more precisely, or add rinsing mechanisms to the individual containers.«

The University Furtwangen team received second prize for their innovative spirit at the 2017 WAGO Cloud Championship.

IDEAS Engineering Consultants – Third Place, 2017 WAGO Cloud Championship

THE FLEXIBLE DATABOX

Recording data, digitizing it, and profitably linking it together – without engaging in ongoing production processes or interacting with the existing equipment controls. The IDEAS engineering consulting firm from Lower Franconia has found a simple path to autonomous machine monitoring: A mobile measuring system that can be flexibly adapted to its environment, linked to a cloud infrastructure using the WAGO PFC200 IoT Controller, and processed with other data recorded in the cloud for further analysis. Customer expenses are minimal.

The reward: Third prize at the WAGO Cloud Championship.

"Our primary focus has been creating an idea that customers could use to easily record the data from their equipment. Since the systems are subject to certain strictures, like equipment security or the Product Liability Act, the technical engagement with the machine controls should be minimized," explains Christian Müller, owner of IDEAS. To visibly demonstrate the idea, he and his colleague Andreas Kröber produced a

Andreas Kröber and Christian Müller from the IDEAS engineering consulting firm had a compelling solution in their mobile measuring system. "Our main focus was to create a concept that customers could use to easily record data from their equipment."

Andreas Kröber produced a machine controller equipped with a PFC100 that is linked to an assembly line model.

machine controller, which is equipped with a PFC100. And when it's linked to an assembly line model, uses simple light signals to report states – error, setup, production – locally.
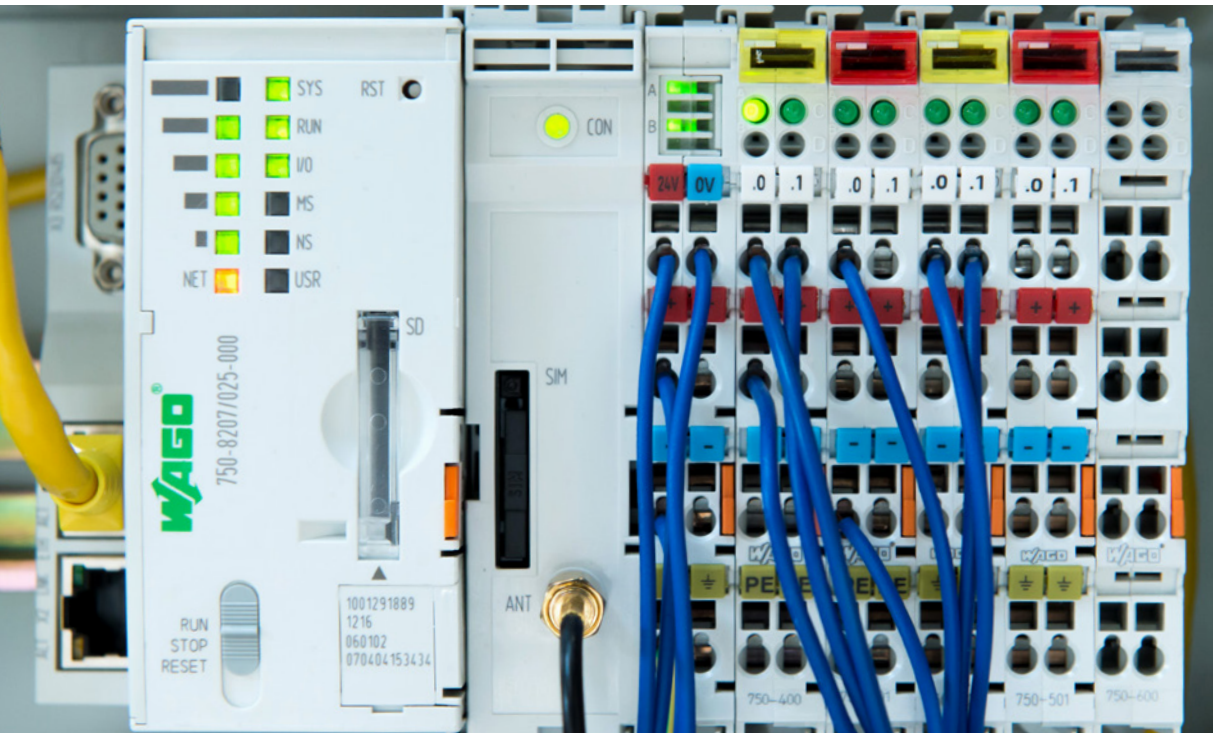
Simply Risk-Free

For digital expansion, the two electrical engineers linked a PFC200 GSM controlled box to the model. One system that could basically be used for all production equipment, regardless of manufacturer. The link to the mobile measurement box is established at the respective machine controller using potential-free contacts. These are either already present or can be easily retrofitted. This way, the measurement system does not connect to machine interfaces that are critical for security, like an ETHERNET port, for example. "Manufacturers do not really want to allow any third parties access to their machine interfaces, and the topic of IT security also serves as a foundation in our model. Our system does not require a link to our customer's IT," emphasizes Müller. Only "one-way communication" is possible, due to the potential-free contacts. "Even if our system got hacked, or the box would show an error, this would not impact equipment security or ongoing production. The worst case scenario would be a temporary stoppage of the data logging," explains Müller. This is the great utility of his zero-risk solution.

OEE in Focus

The status signals – error, setup, production – are recorded in the IoT-capable PFC200, which also receives information from the system about the number of units currently produced via counting

The status signals – error, setup, production – are recorded in the IoT-capable PFC200, which also receives information from the system about the number of units currently produced via counting pulse.

pulse. From these system states and/or values, the overall equipment effectiveness value is calculated in the measurement box controller program. This occurs before the controller sends the data from the field level to the cloud in real time, where the data are aggregated and presented in the cloud portal in visual format to facilitate analysis for the user. In addition to the system states, message transmission is also implemented in the cloud portal. Transmission enables, for example, maintenance to receive a push message in the case of system errors. "However, the controller is not coupled to the WAGO Cloud Data Control in this case. Because the championship deadline was rapidly approaching, we chose a different cloud solution for practical reasons. We had already implemented a similar project using this cloud solution, and had a similarly good experience." Linking the WAGO PLC to third party solutions was, however, seamless thanks to the

standardized MQTT protocol. Customers can thus be secure in monitoring the state of their systems at any time and anywhere in the world – a fantastic idea from Lower Franconia!

TEXT ALBERTO ALONSO MALO | WAGO

PHOTO ANAND ANDERS | VOR-ORT-FOTO.DE

Jury Assessment of IDEAS Engineering Consultants: Mobile Measuring System

The mobile measuring system from IDEAS intrigues with its simplicity and flexibility – the product can be seamlessly used in many applications. The Box and the linked cloud application can collect information, regardless of region or geography and evaluate it holistically. The Box can also be connected quickly and easily to devices – an approach that conforms to industrial standards, and one in which WAGO products can be used flexibly and with versatility due to the breadth of the system. The measurement system has also clearly demonstrated how our products can function outside of WAGO solutions.

»We solve a specific problem with our box.«

As the owner of the IDEAS engineering consulting firm, Christian Müller regularly works with WAGO Controllers – the advantages of the IoT-capable PFC200 impressed him during the development of his mobile measurement system.

WAGO went looking for Cloud Champions and you were there, front and center. How surprised were you that your mobile measurement system was so well received by the jury?

» We initially became aware of the competition through our field workers from WAGO who have a very good connection with us. We also read a few things here and there about it. However, we did not think at the beginning that our idea had the potential to be a winner in the competition. «

Did you already have plans for the measurement system? Or did you develop the idea specifically for the cloud championship?

» No, we had already produced the concept and the technical realization – including the machine controller and the assembly line model. We prepared the mobile measurement system last year for one of our customers, who gave a presentation about it at a trade fair on Industry 4.0 as an exhibitor. In the meantime, we'd begun marketing the system. An expanded version of it has been used at a water treatment plant in Malaysia. «

Christian Müller is a WAGO loyalist, through and through: "WAGO offers a complete package with the PFC family. The controllers have all of the approvals, and satisfy the standards and specifications that we need both here and abroad."
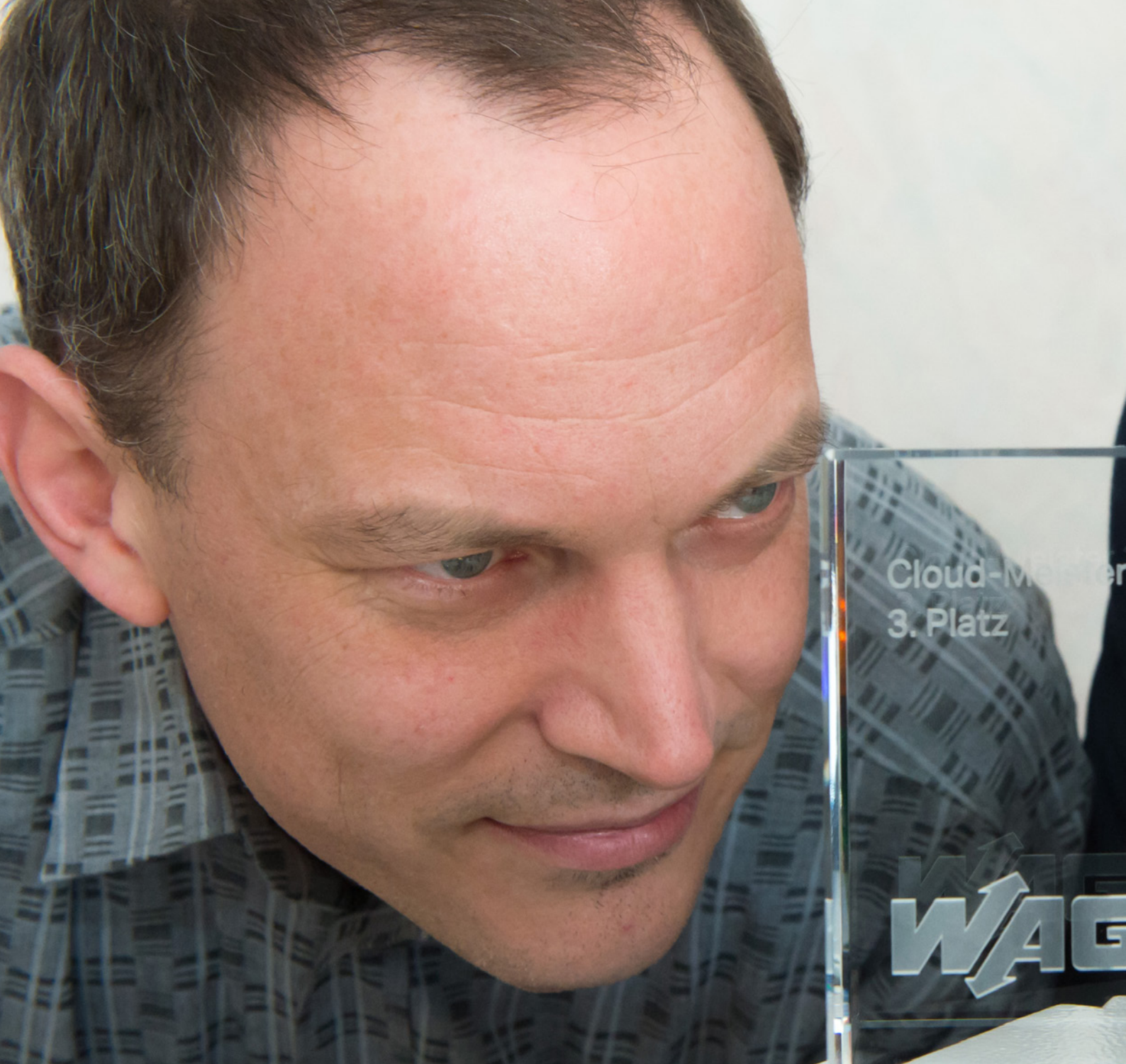
What explicit advantages do you see in your invention?

» Let's take an average mid-sized operation, which still has several older machines in the assembly line. The systems function seamlessly; however, they have no additional electronics installed. Linking this type of machine into a system to record data and determine OEE values is simply not possible without interrupting production. This is the problem we solve with our box. It can simply be connected in any control cabinet. We set up one potential-free interface, and we're done! The equipment continues to run during this brief intervention. Cloud connection is established using a cloud adapter, which is offered by the cloud host we have selected, and was specifically programmed for the WAGO PFC and tailored to the controller. The recorded data can be accessed by any mobile device, anywhere around the world, using the cloud. Mobile access means that the company does not need their own costly IT infrastructure. «

What previous experience have you had with WAGO?

» We have relied for many years on WAGO products in our projects. The controllers are robust and can be modularly expanded; they can also be tailored to the individual desires and needs of our customers. In relation to the mobile measur-

ing system, the recording and analysis of other key indicators is also possible, for example. Additionally, WAGO offers a complete package with the PFC family. The controllers have all of the approvals, and satisfy the standards and specifications that we need both here and abroad. We can set up our box, regardless of equipment manufacturer, and read in every machine type. And the customer receives a uniform solution with everything contained in one device. We also have a super support team, in case questions occur or problems arise. «

Champions, without antici-pating it: "We did not think at the beginning that our idea had the potential to be a winner."

After completing his degrees in mechanical engineering and economics, Dr. Thomas Holm wrote his dissertation about automation technology at the Helmut-Schmidt University in Hamburg. He has worked for WAGO Kontakttechnik GmbH & Co. KG since 2015, and is currently responsible for Automation Research and Development. He is also the author of numerous national and international publications focusing on adaptable production structures.

»WE WERE VERY INSPIRED BY DIVERSE IDEAS!«

Dr. Thomas Holm, Head of Innovation & Technology at WAGO, sat on the four-person jury that evaluated the ideas during the 2017 Cloud Championships. This was no easy endeavor, as he recalled.

Last year was the first time WAGO held a competition for the Cloud Champion – what compelled the firm to do so?

» **Thomas Holm:** We see ourselves, and our products, as facilitators who enable our customers to implement their ideas. Our intent was basically to gauge how we could adapt to these types of ideas and applications when we were not directly involved in the products used for them. Being inspired by the developers and users, who implemented our products in such unique ways, was another tremendous benefit of the championship. However, regardless of the creativity demonstrated, the ideas presented had to conform to WAGO standards. «

Are you satisfied with how the championship played out? With the applications you received? And, ultimately, with the results?

» **Holm:** Absolutely. The competition of ideas had an incredibly successful debut – we received more applications and a greater breadth ideas than we were expecting when we began. However, it was also very difficult, due to the wide variety, to compare the applications with one another. The contributions were often not even on a comparable scale. For example, one applicant automated his entire house using WAGO.

He then made the information available for mobile devices via home automation to monitor different parameters. He had a great presentation for the jury, and our hearts nearly burst when we saw how much loving detail he had put into his project. Of course there was also a number of other applications that did not directly align with cloud-controlled building automation. «

How did the jury determine the ranking?

» **Holm:** We set up clear criteria to create commonalities. Has the approach been thought through thoroughly? How was the idea technically implemented? What is the degree of innovation? How often have we run into this idea before? These are just some of the points. And naturally, we focused on finding more marketing opportunities for WAGO – this was not meant to just be entertaining. «

MEASURE, CONTROL, SAVE

The Andechser Molkerei Scheitz, a dairy processor, requires detailed, informative data for their energy management. So they rely on measurement technology innovation from WAGO: The new current and voltage tap for 2-conductor 95 mm² (4/0 AWG) through terminal blocks. Due to its compact design, it is also perfect for densely populated control cabinets.

The Andechser Molkerei Scheitz Dairy can improve efficiency and their energy balance sheet by using WAGO measurement technology.

The Andechser Molkerei Scheitz lies forty kilometers southeast of Munich, where Bavaria appears like a picture book with Lake Ammer below and the Alps on the horizon. Around 630 organic farmers from the foothills of the Alps supply the company with milk. In order to make creamy butter, fruity yogurt, and other high-quality products, the largest organic dairy plant in Europe uses quite a bit of energy. Efficiency is therefore a high priority. According to the Scheitz Dairy philosophy, the contract for organic agricultural producers obligates the company to act in an environmentally sustainable way. Therefore, the company from Andechs considers it their responsibility to use innovative technology to continuously reduce energy consumption, and thus contribute to environmental protection. This means that the electricity and heat used in 2018 should be lower than for the previous year by several percentage points. Significant savings were already achieved in 2017. The continuous quest for greater efficiency has also paid off economically, as energy represents one of the major costs to the company.

The most important tool for successfully implementing this strategy is reliable and flexible measurement technology and software for comprehensive energy control. This allows the dairy plant to conduct multiple evaluations, generate time comparisons, or establish relationships to production amounts. This, in turn, allows them to determine the amount of energy consumption per yogurt produced. The dairy plant then derives efficiency measures from these values, or they can also be used to check how effective such measures are. In addition, the system enables tracking of the carbon footprint of individual products. According to Andechser, this is important information, which is included in the company's environmental statement. Beyond merely reducing tax costs, the systems help to reduce other expenses for the dairy plant thanks to increased transparency. The company can also consider the easing of electrical taxes and network charges in their accounting.

Easy and Reliable Handling

Even though the operation currently profits from its energy management, collecting the data took considerable effort. "At the beginning, we did not know how the data came into existence. The previous system was a black box that only offered a limited range of functions," reports Christoph Ehrensperger, who acts as project manager and programmer at the Andechser Molkerei Scheitz. In addition, they learned along the way that some of the data were simply wrong. Ehrensperger explains another annoyance with the system, "The measurement technology was so niche that we regularly needed external support – even to link in a new piece of equipment." Since the dairy facility was constantly growing and investing in new production technology, this led to substantial effort and additional costs.

These were good reasons for the company experts to look around for a more reliable alternative that would be easier to deal with. They quickly struck it rich with a measurement technology innovation from WAGO. The firm's new 855-951/250-000 Current and Voltage Tap for 2-conductor Through Terminal Blocks, up to 95 mm², with an integrated current transformer (conversion ration 250 A/1 A), taps all relevant energy data directly at the feed in. Energy data is then transmitted via WAGO PLC to a PFC200 in the energy control center. The technology is complemented by WAGO terminal block assemblies for current and voltage transformers, 2007 Series. The dairy has used automation technology from WAGO for many years. They know that WAGO products are reliable and powerful. According to management, the decision to use WAGO measuring technology was an easy one to make.

Around 630 organic farmers from the foothills of the Alps supply milk to the Scheitz dairy in Andechs. In order to make creamy butter, fruity yogurt, and other high-quality products, the largest organic dairy plant in Europe uses quite a bit of energy.

Quick and Easy Installation

The WAGO measurement technology impressed the experts at the dairy due to its compact, clever design. The current and voltage tap has the same width as the 2-conductor through terminal block for conductors up to 95 mm² (4/0 AWG). Another converter or specialty mounting unit is not necessary. Due to this integrated, modular approach, the current and voltage tap does not require additional space in the control cabinet. This compact design is a great advantage for Andechs where space is limited. The dairy uses the product in their existing control cabinets; therefore, its compact design is important.

The integrated fuse also contributes to optimal utilization of space in the control cabinet, according to Ehrensperger. The SIBA fuse (2 A, 450 V, F, 70 kA), is located directly above the voltage-carrying tap and is equipped with a detector. "Since the fuse is part of the voltage tap in the terminal block, we don't have to worry about the arrangement in the control cabinet," explains the expert. WAGO offers two different versions; the installed components can be easily and clearly marked. This makes things clear in the control cabinet and prevents errors.

Installing the current and voltage tap is child's play: Simply plug it into the jumper slot on the terminal block. "This saves a great deal of time and money," says Ehrensperger. The possibility of jumping on the secondary side of the current transformer also proved helpful during commissioning. "Without this function, there could

be circumstances in which it could be damaged during normal operation. Since we only completed the wiring of the measurement technology a few weeks later, we used this function to the fullest extent during various tasks," according to Ehrensperger.

First Logistics and Control, Then Production

The dairy incorporated the WAGO measurement technology gradually across the entire company. This process has already been completed in the control center and logistics, where it was used as a pilot project. Since the WAGO current and voltage tap satisfies the requirements of accuracy class 0.5, Germeroth and his colleagues can rely on precise results.

The new WAGO product is also already at work the production area. The dairy experts from Andechs have begun measuring energy consumption when filling yogurt into glass containers. The company uses the measurement data to derive key indicators related to the production levels. In addition, they gain information about potential efficiency measures. Over the next months, the conversion to WAGO measurement technology will occur in the entire production area.

UPGRADE: EVEN GREATER PERFORMANCE FOR THE PFC200 CONTROLLER

WAGO increases the performance of the PFC200 Controller with a hardware upgrade, beginning in mid-2018. The performance increase results from the higher pulse frequency of the processor and the larger memory. In addition, the standardized MQTT protocol ensures seamless connection to web and cloud services. The hardware upgrade is accompanied by a new release of WAGO's *e!*COCKPIT Software (Version 1.4) for greater engineering convenience.

With this upgrade, all of the diverse controllers within the PFC200 Series – along with their various interfaces – provide even more options for future-proof solutions in system and mechanical engineering, as well as manufacturing and process technology. Developed with an eye on cybersecurity, SSL/TLS 1.2, SSH, VPN and a firewall come standard.

Greater performance results from:

- A faster CPU
- Larger RAM and flash memory
- Improved processing of larger data volumes

Save Time and Money

The new Version 1.4 of WAGO's *e!*COCKPIT Engineering Software offers a Python interface that enables automatic loading of applications onto the controller, for example. The "Static Analysis" and "Profiler" expansions, available separately, improve the evaluation of program code so inconsistencies or bottlenecks in execution can be found more quickly. So inconsistencies or bottlenecks in execution can be found more quickly. Users of *e!*COCKPIT v1.4 will benefit immediately from software modules offered in the 3S Online Store, which is conveniently integrated into the *e!*COCKPIT user interface. *e!*COCKPIT v1.4 will be available in the first quarter of 2018.

Top Advantages of the PFC200 Upgrades at a Glance:

- More RAM memory for improved processing of larger data volumes
- More powerful processor for faster programs and faster processing
- Improved storage for bigger applications due to larger Flash memory
- MQTT protocol as standard connection to WAGO cloud solutions, Amazon Web Services, Microsoft Azure or IBM Bluemix
- *e!*COCKPIT version upgrade for greater engineering convenience
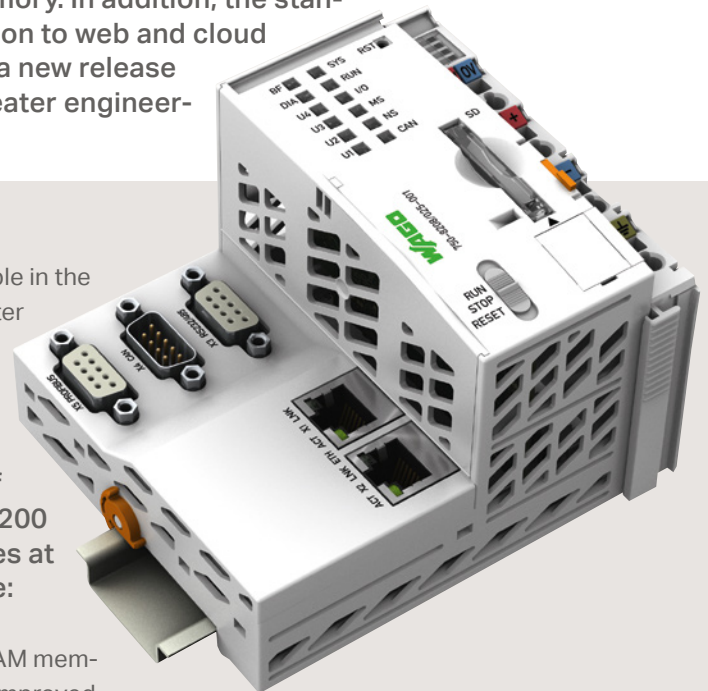
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